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PC MAGAZINE

VOLUME 8 NUMBER 10
MAY 30, 1989

PC Labs Tests EVERY 80386

- 33 bargains at 16 MHz
- 46 workhorses at 20 MHz
- 25 screamers at 25 MHz

386

104 Hands-On Reviews

PLUS

- Why the 386 Is the Machine to Buy
- How to Buy Smart—with No Regrets
- Why the SX Chip Defines the New Entry Level
- How About the 486?
- First Looks: Zenith Pulls Ahead at 33 MHz

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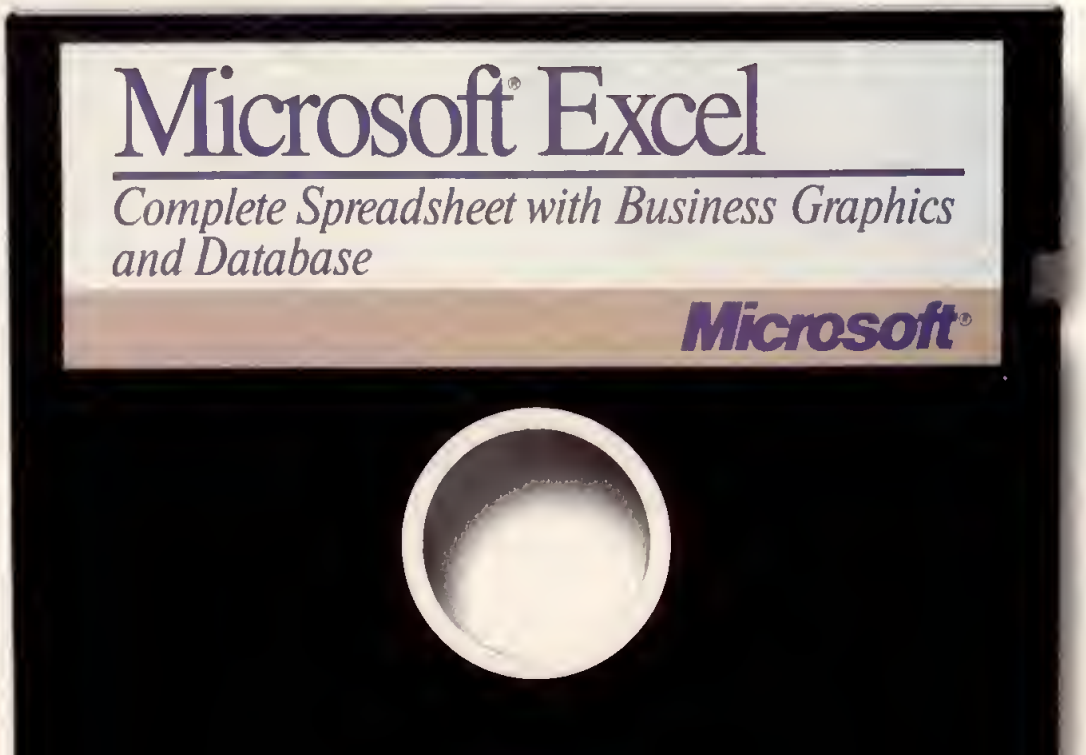
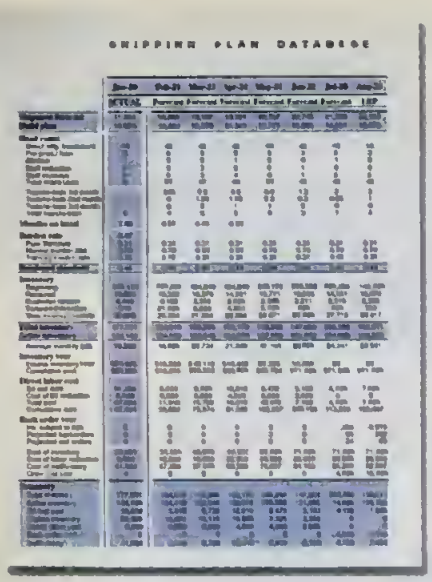
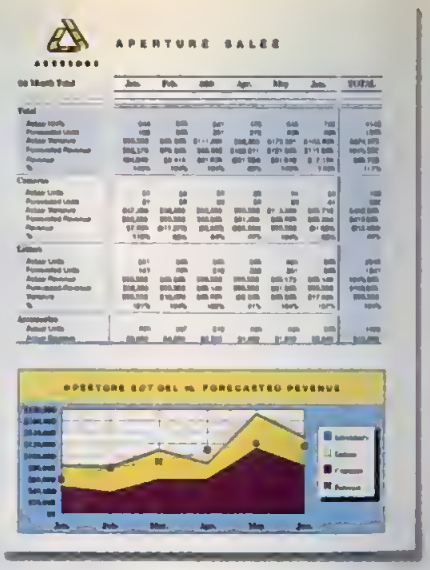
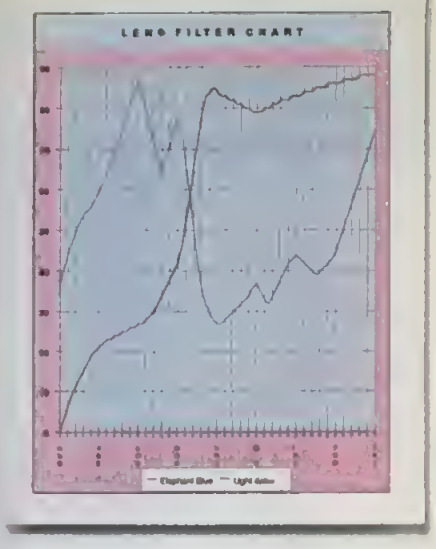
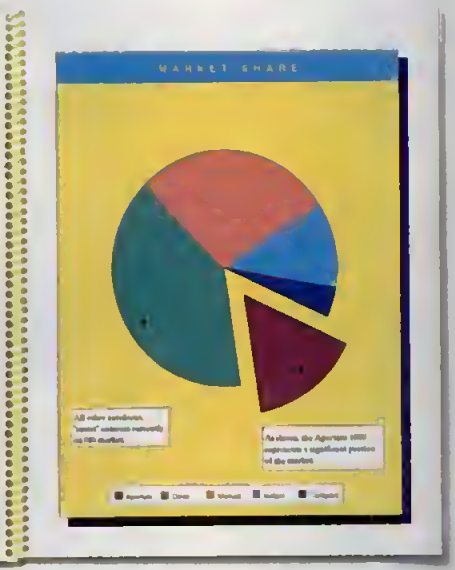
When 1-2-3 users finally make the decision, they'll be amazed at what happens.

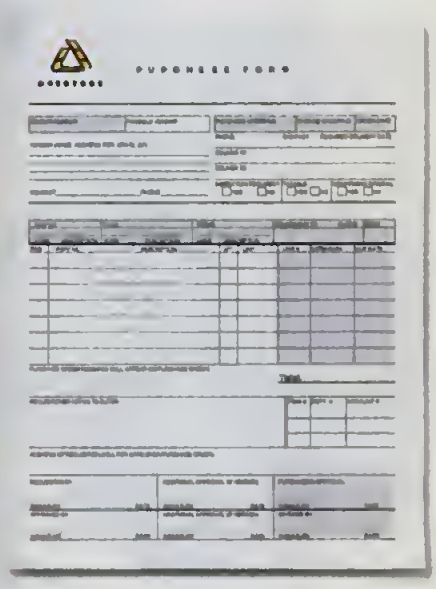


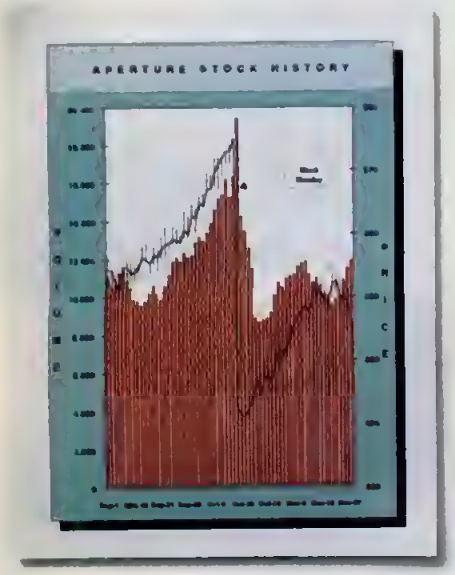


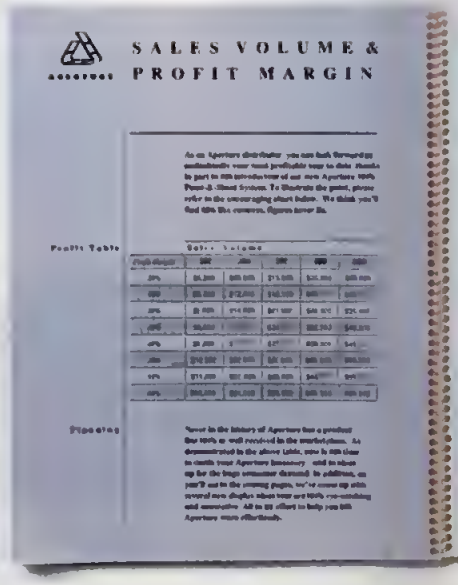


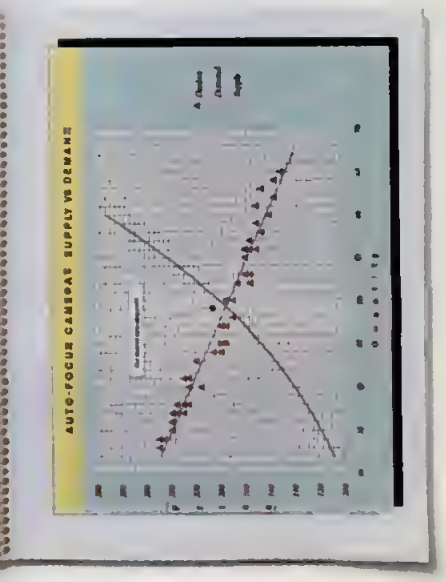












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VOLUME 8 NUMBER 10

WHAT'S INSIDE

Never before has $2.95 been worth so much to so many. There was a time when $2.95 bought a frock coat and breeches. But even with that degree of buying power, it couldn't command 25,000 hours of work by 60 people testing and reviewing 104 386 PCs.

No other computer publication has ever attempted such a feat: to hands-on-test every 80386-based desktop computer in existence. The closest another magazine came was a roundup of 24 20-MHz 386s, and the highest number *PC Magazine* reviewed at one time was 15.

Writing, testing, editing: you name it, Team 386 did it—over 25,000 hours of hands-on work to review 104 computers.

Team 386 began last summer in the PC Labs conference room with just two editors, one project leader, a free-lance writer, and three or four assorted techies. In theory we were assembled to flesh out the authors' guide, but the first questions to surface focused on more-immediate practical concerns. Where are we going to put them all? How will we get them photographed? What if there are 200 of them out there?

The last question led to a debate that went unresolved through a full 6 weeks of editorial meetings. Associate editor Ed Perratore and I, who worked together to produce this issue, were struck by something close to terror at the thought of simply running out of inventory and Labs space. We could handle 100 computers, but could we handle 150? Or more?

We thought of various "filters" to screen out the expected overflow; the ideas ranged from cutting out 16-MHz machines to eliminating 386s with chips oscillated beyond their ratings. But in the end we surrendered ourselves to Fate and the magical process of vendor dropout. *PC Magazine*'s comprehensive special-issue format survived the process.

The trivia doesn't end with an accounting of man-hours. The features table that appears in this issue, when printed out on a dot matrix printer, covers a 10- by 12-foot office's floor. The number of electronic-mail messages ferried among editors, reviewers, and labs personnel totals over 500. But more important than these statistics is the shelf life of this issue—counted not in hours or square feet, but in years.—Stephanie K. Losee PC

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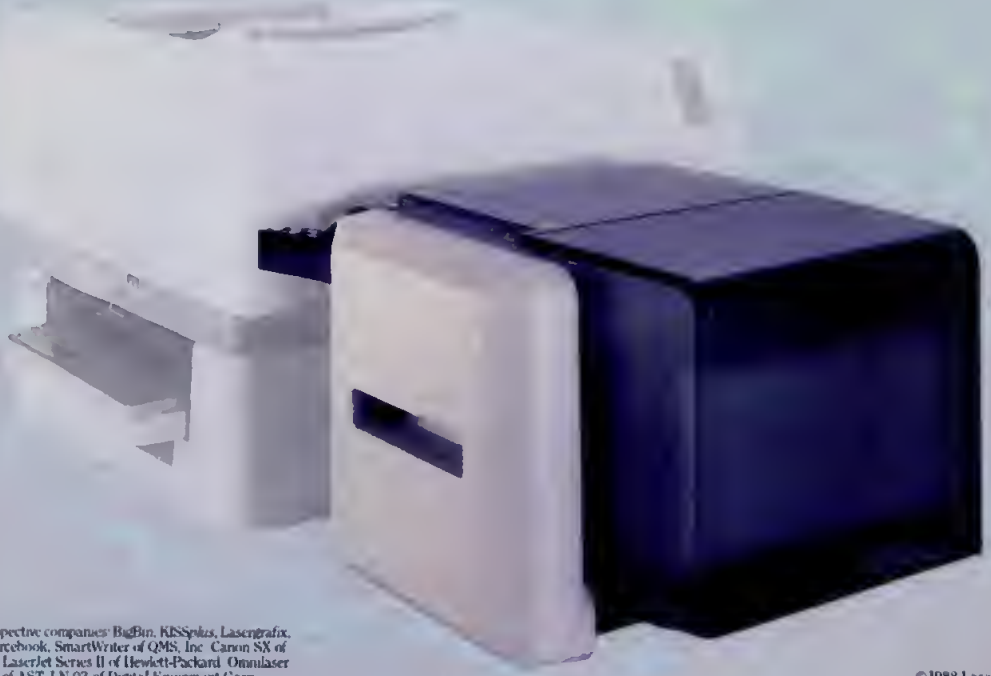

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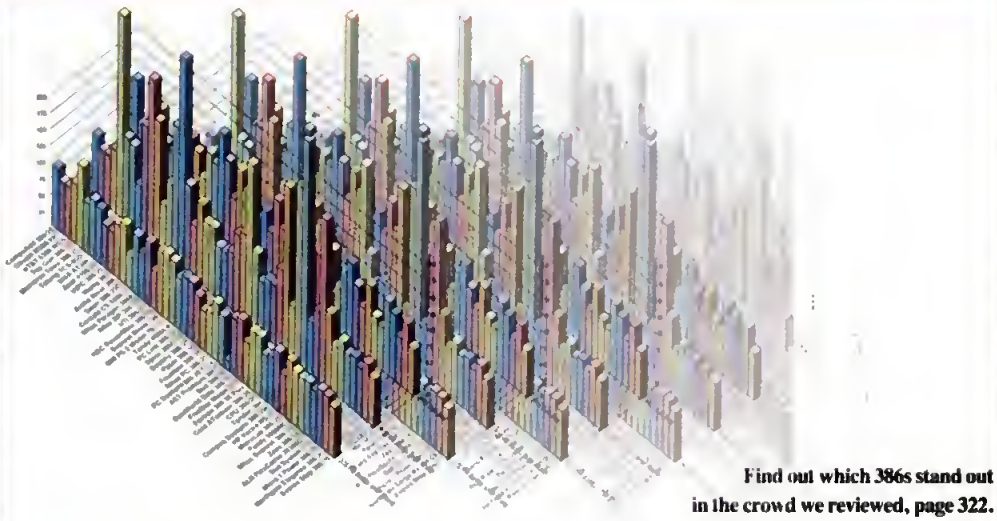
PC MAGAZINE ®

COVER STORY

80386: The Power and the Glory

Join in *PC Magazine*'s celebration of the 386-based personal computer—an entire issue devoted to its technology, performance, and potential. In the most comprehensive 386 roundup ever published, we test and review a total of 104 desktop PCs representing 58 companies in all.

Editor-in-chief Bill Machrone analyzes the 386 microprocessor's impact on computing in today's world and tomorrow's. And to give sharper perspective to our reviews, we size up the 386SX as an increasingly attractive option, reveal the truth—beyond the rumors—about Intel's 486 chip, and step you through a smart buying plan so that you choose a system you won't



Find out which 386s stand out in the crowd we reviewed, page 322.

regret later 95
16-MHz Performance Tests 170
20-MHz Performance Tests 180
25-MHz Performance Tests 196
Features Table 263
Editor's Choice 322

Index of Reviews

Acer Technologies Corp .. 106
Advanced Logic Research Inc 110
Altec Technology Corp ... 112
Amax Engineering Corp .. 115
Amdek Corp 117
American Mitac Corp 118
Arche Technologies Inc ... 122
AST Research Inc 125
AT&T 127
Bus Computer Systems 128
Canon USA Inc 135
Compaq Computer Corp .. 135
CompuAdd Corp 138
Computer Products United Inc 141
Computer Systems Corp .. 142
Continental Technology Inc 144
Cordata Technologies Inc . 148
Core International 153
DataWorld Inc 162
Dell Computer Corp 164
Destiny Computers 166
Everest Computer Corp ... 177
Everex Computer Systems 183
FiveStar Computers 188
Fortron Corp 188
Fountain Technologies Inc 201
General Technology Corp. 202
Hertz Computer Corp 204
Hewlett-Packard Corp 209
HiTech International Inc .. 210
IBM Corp 212
Laser Digital Inc 220
Leading Edge Hardware Products Inc 222
Memorex Telex Corp 225
Micro Express Inc 230
Micro 1 Inc 236
Mitsubishi Electronics America Inc 238
NCR Corp 240
NEC Information Systems Inc 242
Northgate Computer Systems 248
Olivetti USA 250
Pan-United Corp 253
PC Designs Inc 260
PC Link Corp 262
Sanyo Business Systems Corp 280
Spear Technology Inc 280
Tandon Corp 286
Tandy Corp 286
Tatung Company of America Inc 294
Televideo Systems Inc 296
Tussey Computer Products Ltd 301
Uniq Tech Inc 303
VIPC Computers Corp 304
VNS America Corp 308
Wang Laboratories Inc 310
Wyse Technology 312
Zenith Data Systems 316
Zeos International Ltd 319

EDITORIAL PRODUCT INDEX

A list of products reviewed in this issue, plus a guide to utilities, programs, and tips in the Productivity section ... 466

Cover Image:
PC Magazine

FIRST LOOKS

Hands On:

- The first 33-MHz 386 out of the gates: Zenith's Z-386/33
- *Lucid 3-D*, Version 2, adds graphics, larger models
- Microsoft's QuickC 2.0 gives programmers a few new features to cheer about
- *PC-MIX:* a novice-minded approach to DOS multitasking
- *Volkswriter 4* helps you put an end to poor grammar
- *Actor* 1.2: An object-oriented *Windows* programming assistant
- *SLEd Image Processor* adds graphics to text-based applications.....33

AFTER HOURS

- CompuServe role-playing games: respites from reality
- The Source's fourth Portfolio Contest: An investment simulation
- *Fantavision* generates "movies" on your PC screen
- *Manhunter:* New York—after the space aliens take over
- *Paperboy:* Delivery mayhem
- *Create with Garfield:* Fun for fans of the comic cat ... 476

***Manhunter* has detailed graphics of New York's urban landscape, page 476.**

PRODUCTIVITY

PC LAB NOTES
Multitasking Without OS/2
Winn L. Rosch/ Both *Microsoft Windows/386* and *DESQview 386* give your 386 machine multitasking capabilities with today's DOS applications. Here's how to optimize the environments' performance..... 329

UTILITIES
Printer Control the Easy Way
Jeff Prosise/ This easier, more-flexible upgrade of our popular SETUP utility lets you tell your printer exactly how to print a file—and you never have to leave your application 345

ENVIRONMENTS
IBM's OS/2 1.1 Programming Tools
Charles Petzold/ IBM's technical documentation for OS/2 1.1 and the Presentation Manager is formidable, running to more than 3,000 pages. Here's a concise breakdown of what you get and what to expect from the people at Microsoft 371

POWER PROGRAMMING
Using Extended Memory, Part 1
Ray Duncan/ Writing programs that access memory above the normal DOS 1MB barrier requires shifting in and out of protected mode. This is a tricky process, but here are the ways you can do it 377

SPREADSHEET CLINIC
Douglas Cobb and Steven Cobb/ Protecting your *1-2-3* worksheets from prying eyes; determining the median in a range of values; a *1-2-3* macro for replacing the value in a cell with a value calculated from it 391

USER-TO-USER
Neil J. Rubenking/ Comparing the contents of two directories with COMP; a verify feature to make sure you don't delete the wrong files; a simple deletion technique that makes it easy to recover your files 395

POWER USER
Craig L. Stark/ Make your network printer wait for a sheet of letterhead stationery; an easier way to find style sheets in *Microsoft Word;* underline and bold *WordPerfect* text with one macro.....409

CONNECTIVITY CLINIC
Frank J. Derfler, Jr./ The difference between software that is usable on a LAN and software that uses a LAN; some data switches don't just deliver mail— they read it; a free T-shirt offer from PC LAN Labs.....415

VIEWPOINTS

LETTERS TO
PC MAGAZINE.....15

PC ADVISOR
Lori Grunin/ How to get the most out of a 386's expanded memory; turning off NumLock from your AUTOEXEC.BAT; an MCA game card 27

BILL MACHRONE
The Thrill Is Back 65

JOHN C. DVORAK
The Sun Clone Also Rises .71
Inside Track.....73

JIM SEYMOUR
The Windows Test.....77

WILLIAM F. ZACHMANN
Adventures in
Cyberspace 83

STEPHEN MANES
Any Day Now: Engines of the
Future.....91

Direct Marketing
Connection 417
Marketplace.....442
Coming Up 466
Reader Service Card ..467
Index to Advertisers...469
Advertisers Product
Index 471

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Austin 286/12.5 Price Matrix

Choose Monitor Below	Choose Hard Drive Below	Price
EGA Color 640 x 350	40 MB HD (25 ms 1:1)	$2295
	80 MB HD (22 ms 1:1)	$2595
EEGA with Multi-freq. Monitor 640 x 480	40 MB HD (25 ms 1:1)	$2195
	80 MB HD (22 ms 1:1)	$2795

Austin 286/12.5 Cache Standard Features:

- Intel 12.5 MHz 80286 Processor
- GE 1 Year On-Site Service Contract
- 14" EGA Color Monitor
- 16 Bit Paradise EEGA Autoswitch Display Adapter
- 40 MB-25 ms Super Fast Access Hard Drive
- 1:1 Fast Transfer Interleaving Controller Card
- 32K High Speed Hard Disk Cache
- Super PC Kwik Disk Caching Software
- 1 MB RAM (expands to 4 MB on board, 16 MB total)
- Shadow RAM Caching (BIOS Caching)
- EMS LIMM 4.0 Support
- American-Made MotherBoard
- 3.5" 1.44 or 5¼" 1.2 MB Floppy Disk Drive
- Phoenix BIOS
- Keytronics Enhanced 101 Keyboard
- 2 Serial Ports & 1 Parallel Port
- 1 PS/2 Mouse Port
- Clock with Battery Backup
- 80287 Math Co-Processor Socket
- FCC Class B Approved
- Users & Technical Reference Manual
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- Fully DOS & OS/2 Compatible

AUSTIN 286/12 Comparison Chart

Features	Austin 286/12	Check Competition
GE 1 year on-site service	YES	
16 bit high speed display adapter	YES	
25 ms or faster hard drive	YES	
1:1 hard drive controller	YES	
Disk caching software (rated as #1 in industry)	YES	
32K hard drive cache	YES	
1 full MB of RAM	YES	
Shadow RAM	YES	
Surface mount construction	YES	
VLSI technology	YES	
I/O ports fully integrated	YES	
American-made motherboard	YES	

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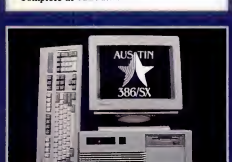

The Austin 386/SX includes a VGA color monitor, 16 bit VGA color adapter, 40 MB-28 ms 1:1 hard drive, GE 1 year on-site service, 1 MB RAM, Super PC Kwik disk cache software, 1.2 MB 5¼ floppy drive, 101 keyboard, and a full array of I/O ports.

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	106 MB-45 ms 1:1	$2795	$2995	
286/20 Cache	40 MB-28 ms 1:1	$2495	$2695	$2895
	80 MB-22 ms 1:1	$2795	$2995	$3195
	110 MB-17 ms ESDI	$3095	$3295	$3495
	150 MB-17 ms ESDI	$3295	$3495	$3695
386/SX	40 MB-28 ms 1:1	$2595	$2795	$2995
	80 MB-22 ms 1:1	$2895	$3195	$3395
	110 MB-17 ms ESDI	$3195	$3395	$3595
	150 MB-17 ms ESDI	$3395	$3595	$3795
386/20 Cache	40 MB-28 ms 1:1	$3395	$3895	$4095
	80 MB-22 ms 1:1	$3895	$4095	$4295
	110 MB-17 ms ESDI	$4195	$4395	$4595
	150 MB-17 ms ESDI	$4395	$4595	$4895
386/20 HyperCache™	80 MB-22 ms 1:1	$5195	$5395	$5595
	110 MB-17 ms ESDI	$5495	$5795	$5995
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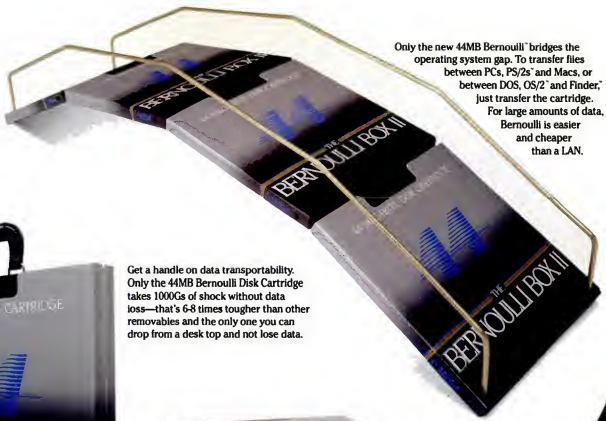

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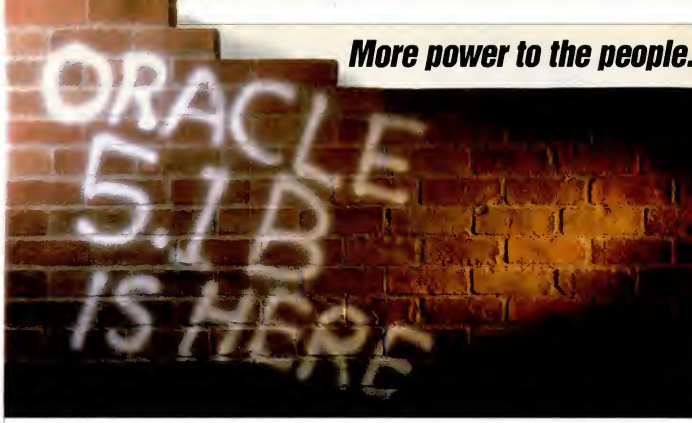

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PC MAGAZINE EDITORS' CHOICE
May 17, 1988

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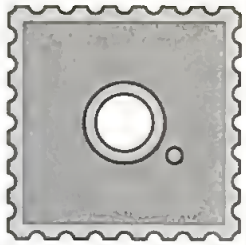
LETTERS TO PC MAGAZINE



BACK TO THE FUTURE

There is and always will be an important need to investigate and report new technology coming on-line in the industry. Remember, however, that you have an ever-growing base of installed users out here. Once potential PC buyers make the purchase, they are no longer so driven to know about the next level of technology. They need to know how to make better use of what they have.

I enjoy reading about the newest line of 20-MHz+ screamers, the best in multitasking software, and so forth, but I would like help in learning how to use what I already have to better advantage. I advocate that *PC Magazine* balance between these two extremes.

Robert P. Ward
Bonney Lake, Washington

There has been a great deal of writing in *PC Magazine* about the latest in hardware, especially the 386 chip. I like the emphasis on different utilities, and I find your reviews to be thorough and specific. Keep up that good work, but remember there are millions of us out here who work on XTs!

George Wilkinson III
Glenbrook, Connecticut

QUICK KUDOS

I want to thank you for the vast amount of time and money I've saved by using the tips and utilities found in each issue of *PC Magazine*.

Scott E. Loveless
Elmwood Park, New Jersey

Thanks for giving me the information to be a smart customer. Based on your review ("The Best of 1988," *PC Magazine*, January 17, 1989), I purchased *PFS:First Choice* despite encountering difficulties with computer salesmen. *PFS:First Choice* is great, and the integrated color graphics make my reports look super!

Lowell Toms
Cincinnati, Ohio

MORE SHAREWARE, PLEASE

Bill Howard did a great injustice when he insinuated that no great software shipped in 1988 ("The Best of 1988," *PC Magazine*, January 17, 1989). He obviously ignored a large portion of the market: shareware.

Shareware is an excellent way for us "common users" to get outstanding products at a reasonable price, on time. Not everyone requires the ultimate product from some distant software house that cannot or will not support the user. For most of us, shareware is a practical, alternative way to greater productivity.

James R. Plosay
Monterey, California

LOOKING FORWARD

I enjoyed and appreciated the reviews on tax-preparation software (After Hours, *PC Magazine*, February 28 and March 14, 1989), but an important piece of information was not discussed: yearly upgrade costs.

J. Gregory Simpson
Savannah, Georgia

LIGHTEN UP, GUYS!

In an otherwise outstanding publication, the After Hours section is a big bore! Most of the time, the products reviewed there are more business-oriented and stuffy than the rest of the magazine. On the rare occasion when you review an actual entertainment-oriented program, it is invariably one that has already become an industry standard for excellence and needs no review.

Despite what most of the computing world thinks, there are a great many high-quality entertainment programs and products available for the IBM PC. Why don't you start reviewing some of them?

Vasilios Spandagos
Tewksbury, Massachusetts

THE TRUE TEST

There appears to have been a lack of quality control in the testing of the multitasking environments ("When One PC Equals Four: 386 Multitasking Environments," *PC Magazine*, February 28, 1989). The more programs there are running concurrently under an operating system, the greater the time a task takes to complete. However, according to the benchmark tests, *Microsoft Windows/386* miraculously managed to actually run all of the *PC Magazine* benchmark tests up to 33 percent faster with four tasks running than with only three!

The second glaring error was that the times presented in the benchmark-test

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■ LETTERS

charts were *only* the times required for the foreground program to complete, regardless of the number of background tests. Most tests involving multitasking environments that attempt to demonstrate performance degradation when adding more tasks do so by at least measuring the time it takes to complete all concurrently run programs in a specific test.

Brian J. Mullen
Tampa, Florida

In deciding how to test multitasking systems, PC Labs selected the criteria we felt would be of greatest interest to readers. We believe the degradation on foreground operation caused by background operations is an essential factor when you are judging a multitasking system. The results for background operation are less crucial since the foreground operation is occupying the user's time.

There was no error on the Microsoft Windows/386 *results. We noticed the anomaly, ran the tests several times, and checked for possible mitigating factors. It's strange but true: three background operations will sometimes cause less degradation than two.*—Ed.

VIVE LA DIFFERENCE

There isn't an issue of *PC Magazine* published in which someone isn't clamoring for the standardization of hardware or software, but frankly, I don't care if it ever happens. My computer has become as much a hobby to me as a business aid, and I enjoy the many hours I spend playing and trying to puzzle through its many little inconsistencies. If it were too logical and easy to use, I probably would have given up on it long ago. Say what you will, but I *like* DOS. Maybe I just don't know any better, but if so, I am blissful in my ignorance. I plan to spend many more years learning about and enjoying my computer.

Lloyd A. Walker
APO, New York

INQUIRING MINDS WANT TO KNOW

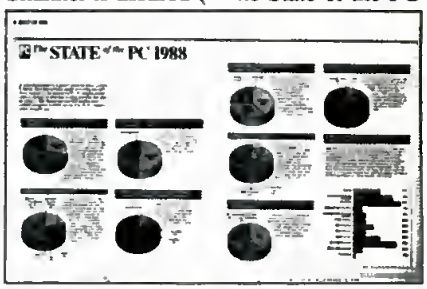
Over the last few years, the trend toward IBM-bashing has grown to the point where you might consider renaming your publication something more appropriate. "The IBM National Enquirer" ought to do nicely, or perhaps "The IBM Star."

William F. Zachmann's column was the proverbial last straw ("IBM at War with the World," *PC Magazine*, January 31, 1989). This column, combined with all the other anti-IBM snide remarks I have read in *PC Magazine*, has brought me to the conclusion that your magazine is never going to "grow up."

R. A. Dumon
Dunwoody, Georgia

OS/2 AHEAD

Although it may not be immediately obvious, based on your PC MagNet survey, it seems that the success of IBM's Micro Channel is assured ("The State of the PC



1988," sidebar to "The Best of 1988," *PC Magazine*, January 17, 1989).

My own prediction is that OS/2 will catch on faster than many users now believe likely. It is quite possible that by the end of 1989, we will see OS/2 versions of *Lotus 1-2-3*, *dBASE*, *Microsoft Word*, *WordPerfect*, and various LAN servers.

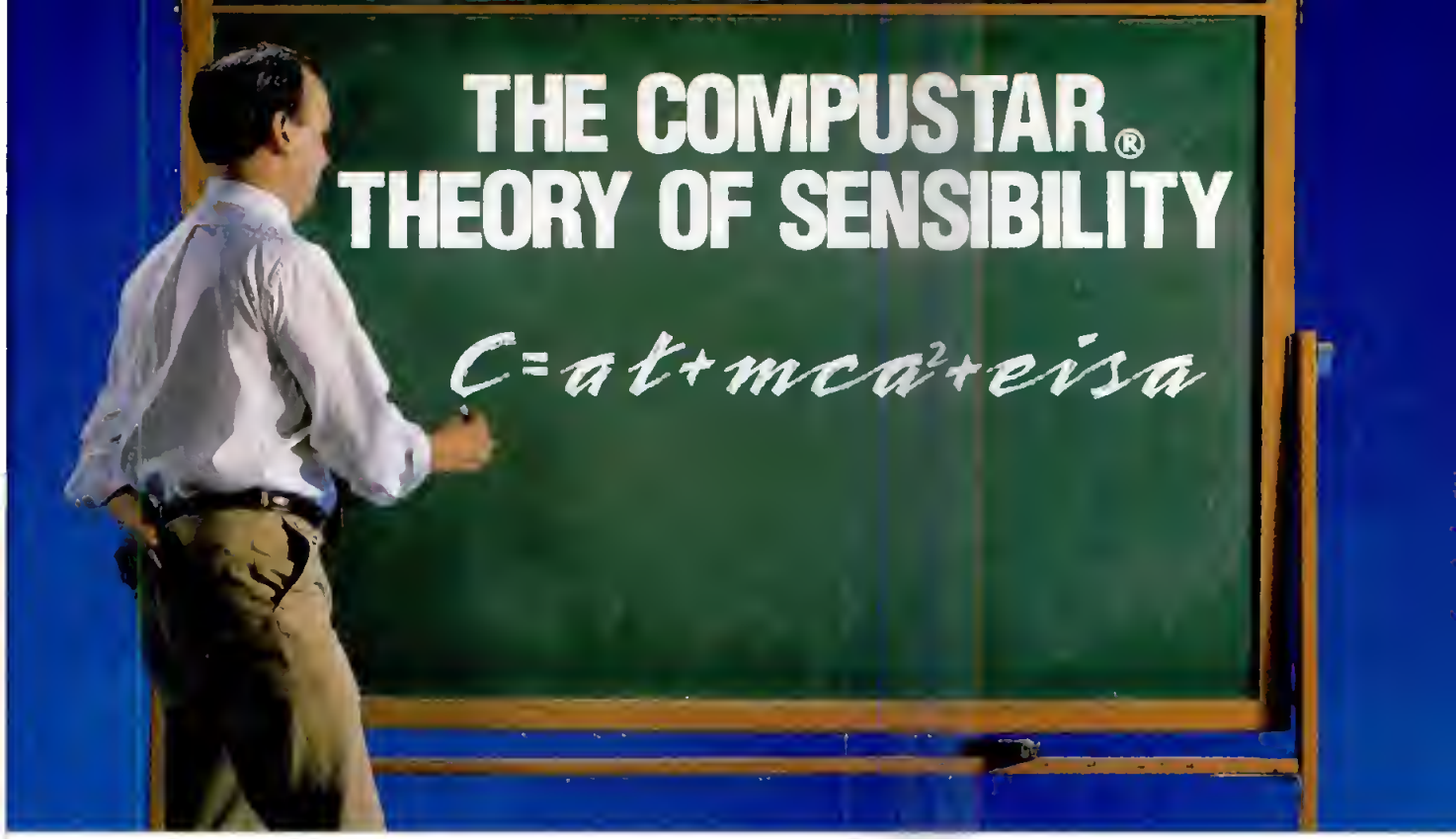
Peter H. Strong
Los Angeles, California

A RICH HERITAGE

Stephen Manes might be interested to know that the language he inaccurately parodies has its roots in English as it was spoken during the reign of Elizabeth I ("Prodigy: It Don't Get No Better Than This!" *PC Magazine*, February 14, 1989), and it has been further developed and enriched for more than 200 years in the United States. I am proud of my origins and do not appreciate having them ridiculed.

Many of your readers are trying to teach themselves about computers. They start out knowing very little and try to progress from there. The information and advice in your magazine are a great help to the autodidact; the ill-tempered insults are not.

Alfred L. Wallace
Milwaukee, Wisconsin



Okay, we admit it may not be as profound as Einstein's Theory of Relativity. But, if you're a computer user, we bet it's a bit more, shall we say, "relative" — not to mention a whole lot more sensible.

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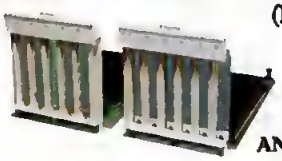

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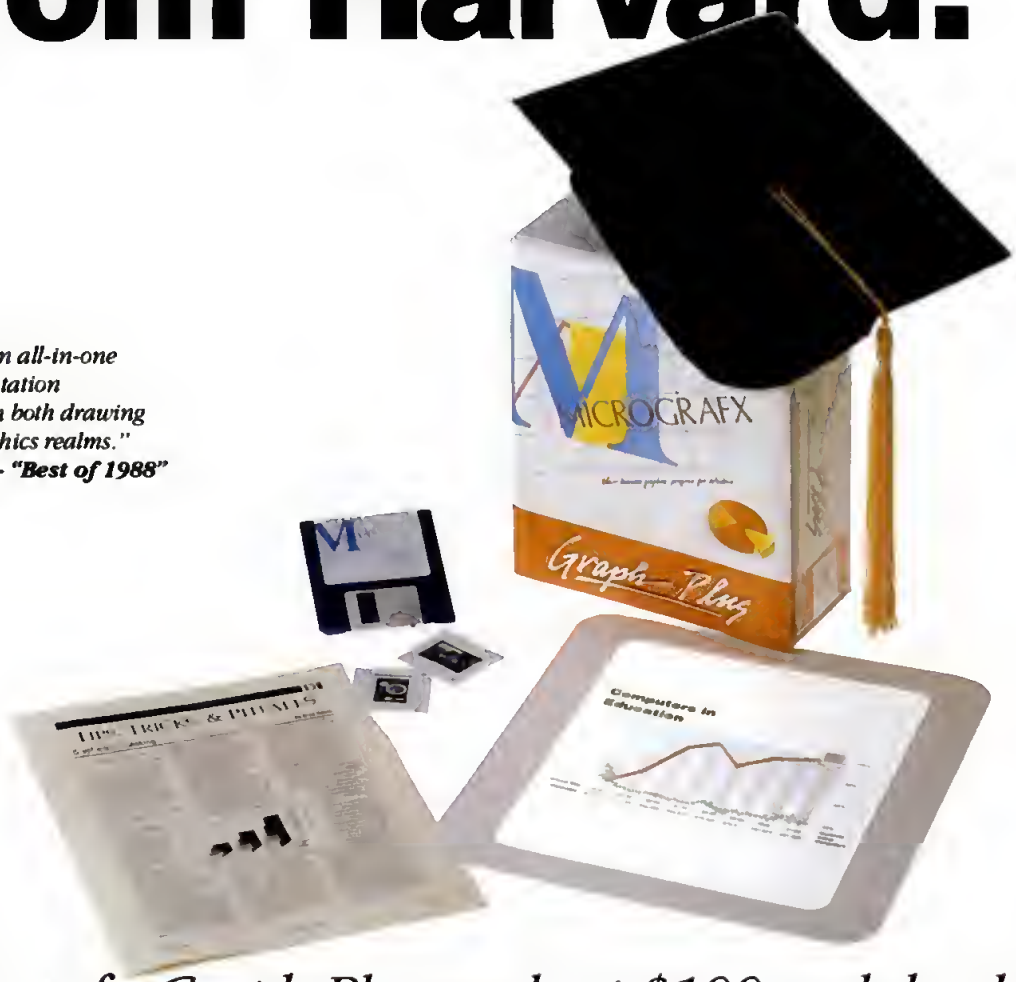

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■ LETTERS

CHECK ALL THE ANGLES

I must agree with Phillip Anderson (Letters, *PC Magazine*, February 28, 1989) about the need for unbiased evaluations by your staff. Encouraged by Charles Petzold's enthusiastic review of the Okidata Laserline 6 ("The 4th Annual All-Printer Review," *PC Magazine*, November 10, 1987), I purchased this printer last year only to discover that Petzold had left out some important information.

■ The Okidata Laserline 6 comes with only 272K of RAM. The RAM can be extended to 656K with a $400 memory cartridge, but memory boards are not supported.

The Laserline 6 comes with only 272K of RAM, out of which only 128K is available for downloaded fonts and page formatting. The RAM can be extended to a total of 656K with a $400 memory cartridge, but the printer does not support memory boards. In addition, the technical support service is minimal *and* costly.

Mike Vranjican
Franklin, Virginia

A CHANNEL'S TRUE PURPOSE

Channels are used to communicate with outboard peripherals, and memory access is a part of the function of the CPU and the DAT box, which performs Dynamic Address Translation ("Coprocessing: Who Needs It?" Bill Machrone, *PC Magazine*, March 14, 1989). The channel may move data to or from memory, but the controlling of it is not the function of a channel.

Steven B. Olson
Bayonne, New Jersey

A LESSON FOR DVORAK

It is an old time-proven axiom that we always attack what we don't understand. Might this be the underlying reason for John C. Dvorak's snide comments about Prodigy Services (Inside Track, *PC Magazine*, February 28, 1989)?

Among its different services, Prodigy provides free daily stock-market prices, bulletin board messages, an airline reservation system, banking and investment services, and weather reports. "It stinks"? No, Mr. Dvorak, you simply haven't learned to use it.

Lucien R. Greif
Chappaqua, New York

NO SOLUTION IN SIGHT

Bill Machrone's description of a book that teaches more about making viruses than stopping them ("Viruses: Sense and Nonsense," *PC Magazine*, February 28, 1989) reminds me of the education of the Army's Special Forces (Green Berets). Their training included a short course ostensibly on countermeasures to torture. The soldiers were taught, in graphic detail, some of the most brutal tortures ever devised by man. At the end of each description, when it came time to teach the countermeasures, the soldiers were told, "There are no known countermeasures."

What do you suppose the Army was really teaching the troops?

Steven Finell
New York, New York

CORRECTIONS/AMPLIFICATIONS

Jandel Scientific's *Sigma-Plot*, Version 3.1, supports both EGA and film recorders, runs from a batch file, and has excellent context-sensitive on-line help ("Scientific Graphing Software: Not Just a Pretty Picture," *PC Magazine*, March 14, 1989).

The correct telephone number for RightSoft Inc., maker of *RightWriter* 3.0 (First Looks, *PC Magazine*, February 14, 1989), is (813) 923-0244.

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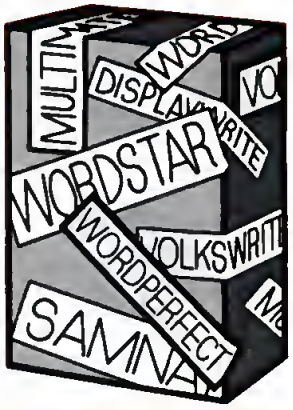

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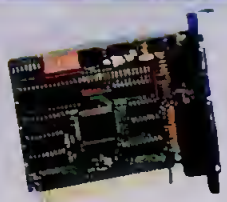

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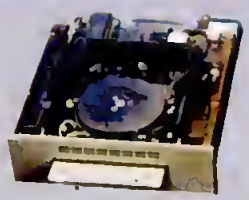

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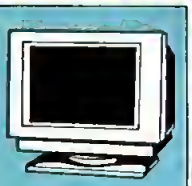

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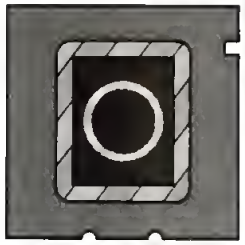
■ LORI GRUNIN



PC ADVISOR

Managing the expanded memory in your 80386-based computer, booting up with your NumLock key off, and finding a game card for the PS/2.

MANAGING 386 MEMORY

I assume that I am not the only one who wants to upgrade from a 286 to a 386 machine, intends to stay with DOS, and needs expanded memory. But I am told that no one builds an EMS board for 386 machines. Why? Is there software that serves the same purpose?

Kenneth Wellner
Mamaroneck, New York

You're absolutely right that no one makes expanded memory boards for 386s—they're not really necessary. Software emulation of LIM EMS on a 386 machine is plenty fast, since these machines use 32-bit memory. With 286 machines, however, you're better off using an expanded memory board: emulating EMS in the PC AT's 16-bit extended memory can be extremely slow.

If you insist, you can use a 16-bit board from your old AT in a 386, but you'll miss the performance advantages of 32-bit memory.

Along the same lines, a 386 machine is perfectly capable of using the same expanded memory manager (EMM) software as a 286. But for optimal performance, you should use software that will take advantage of the unique memory-management capabilities built into the 80386 chip—in particular, its ability to remap extended memory into any address.

Qualitas and Quarterdeck Office Systems offer expanded memory managers that should give you everything that you need. Both of these products were listed among PC Magazine*'s Best of 1988 (see the issue of January 17, 1989).*

Both products emulate LIM EMS 4.0, just as most EMMs do on ATs. But as a 386-based bonus, they also unclutter your precious base 640K by loading well-behaved TSRs into high memory while remapping your system's ROM—generally stored in 16-bit memory—into faster 32-bit RAM (a process known as shadowing). And all this comes without sacrificing more than 2K of conventional memory.

These products are not identical, as their loyal fans are quick to point out. QEMM-386 *($59.95 from Quarterdeck Office Systems, 150 Pico Blvd., Santa Monica, CA 90405; (213) 392-9851) ferrets out the fastest RAM chips in your system to use as your DOS-accessible 640K, and it can load device drivers into high memory. In addition,* QEMM-386 *is optimized for use with Quarterdeck's multitasking environment,* DESQview.

On the other hand, 386-to-the-Max *($74.95 from Qualitas Inc., 8314 Thoreau Dr., Bethesda, MD 20817; (301) 469-8848) seeks out segments of unused memory in the 384K reserved for video RAM, giving you additional base RAM to play with. How much memory you gain depends on your graphics adapter. The newest release of the program,* 386-to-the-Max Professional, *should be out by the time you read this; it will be able to load device drivers into high memory as well.*

■ For optimal performance, use an EMM that harnesses the unique memory-management capabilities of the 80386 chip.

NUMLOCK WOES

When the new 101-key Enhanced keyboards came out, I was glad to see a second set of arrow keys. Our new Zenith, however, boots up with the NumLock key on. Every time I use my word processor, I invariably type numbers when I'm trying to edit or move within the program. Is there any way I can turn off the NumLock key from within my AUTOEXEC.BAT?

Daniel J. Reed
Manhattan, Kansas

You're not alone. Many of the new ROMs boot with NumLock turned on. Not a major crisis in the world of computing, just an action that requires an annoying extra keystroke (which is often irritatingly belated).

But never fear: PC Magazine*'s NUMLKOFF.COM will solve your problem. You can download the program from the Utilities Forum on PC MagNet; then just stick it into your AUTOEXEC.BAT and forget about it. (See the "By Modem" sidebar in this issue's Utilities column for instructions on how to download programs from PC MagNet.)*

■ PC ADVISOR

PLAYING GAMES ON THE PS/2

I was hoping you could help me with what I think is one of the largest irritations of the IBM PS/2 series: the lack of a game port for a joystick. I would appreciate it if you could tell me who makes a game port for the MCA bus, because one is greatly needed by users everywhere.

John E. Stafford
Greensboro, North Carolina

Many people agree with you that the PS/2 isn't just for business anymore. Therefore, I'm pleased to announce that, yes, Virginia, there is a game card for the Micro Channel. CH Products (1225 Stone Dr., San Marcos, CA 92069; (619) 744-8546), maker of peripherals for game players, sells a $79.95 game-control adapter called GameCard III Plus–MCA, a Micro Channel version of its GameCard III Plus. If you prefer to play games à deux, $89.95 buys the card plus a Y-cable that allows you to connect two joysticks.

The GameCard's external switch lets you choose one of three sensitivity levels, ranging from 70,000 to 200,000 ohms, to match the needs of your application. AutoCAD, for instance, requires a lower sensitivity level than does Centipede. CH Products designed the GameCard to avoid the timing problems that may be inescapable with cards meant for machines with slower CPUs—it can be used in machines with clock speeds as high as 20 MHz.

■ If you prefer to play games à deux, invest in a Y-cable to connect two joysticks.

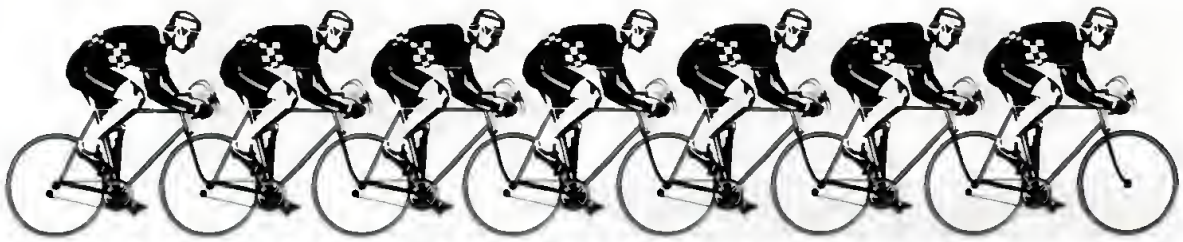
In addition, the GameCard supports four analog inputs, such as paddles, and four digital inputs, such as push buttons. A joystick with two buttons counts as two digital and one analog input; hence the card's ability to support two joysticks.

To install the 8-bit card, you merely slip it into an empty slot—there's no need to run the PS/2 setup program. One caveat: the instructions that come with the card include a one-line BASIC program to ensure that everything is working properly, but this program goes into an infinite loop that can only be broken by rebooting.

Let the games begin!

ASK THE ADVISOR

Send your questions to PC Advisor, *PC Magazine*, One Park Avenue, New York, NY 10016, or upload to PC MagNet (see the Utilities column for access information). Please specify your equipment. PC



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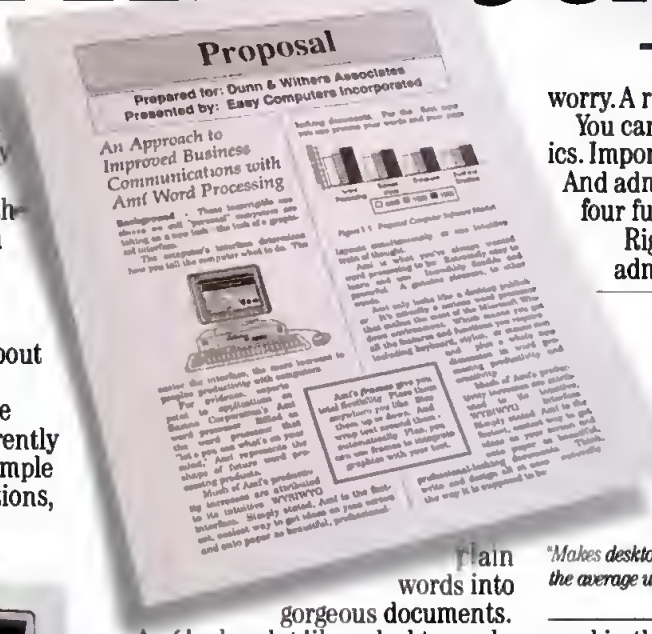

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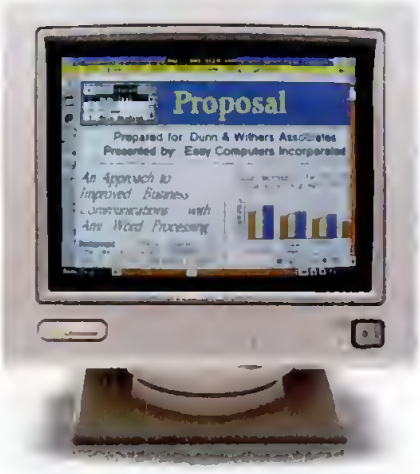

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CIRCLE 195 ON REAOER SERVICE CARO

PC MAGAZINE

FIRST LOOKS

33-MHz 386: Zenith Breaks the Ice

PC PREVIEW

BY LORI GRUNIN

The novelty has begun to wear off, and we can finally stop oohing and aahing over those 25-MHz speed demons, right? Nope. Now it's time to start all over again with the even speedier demons made possible by Intel's 33-MHz 80386 chip.

The first 33-MHz machine to grace the benches of PC Labs bears the Zenith logo and a $7,999 base price comparable to that of a high-end 25-MHz box. Unfortunately, tbe performance of our evaluation machine, an early production unit, was also comparable to that of a high-end 25-MHz system.

The processor in the Zenith Z-386/33 operates roughly 30 percent faster than a 25-MHz chip, so why doesn't the machine reflect the higher speed? In a word: memory. Zenith chose to hobble the Z-386/33 by populating the motherboard with 100-nanosecond DRAM; most high-end systems today use nothing slower than 80-ns. chips.

In addition, the standard configuration comes with only a 16K memory cache—compared with the 32K or 64K caches of the bigher-performance machines.

The news isn't all bad, however. The Z-386/33's cache can be easily upgraded to 32K or 64K, a move sure to improve performance, and the machine seems designed for speed in most respects.

Speed Features

Governed by a Zenith-designed, NEC-manufactured controller, the Zenith's standard 16K memory cache uses 15-ns. memory and features Zenith's 16-layer posted write queue, which stores writes to memory until the CPU becomes idle. Rather than putting the cache memory on tbe motherboard, Zenith places it on a card that fits into a proprietary internal slot, making cache board replacements and upgrades a breeze.

Behind the cache, the standard 2MB of 100-ns. RAM can be upgraded to 32MB on the motherboard, using 1MB or 4MB SIMMs (when the latter become available). 32MB of additional 32-bit slotted memory brings the possible system total up to 64MB.

In addition to the Model 1—outfitted with a 1.44MB floppy disk drive and an I/O controller with one parallel and two serial ports—Zenith offers two hard disk configurations.

(continued on page 35)

Lucid 3-D Adds Graphics, Imports/Exports 1-2-3 Files

PC HANDS ON

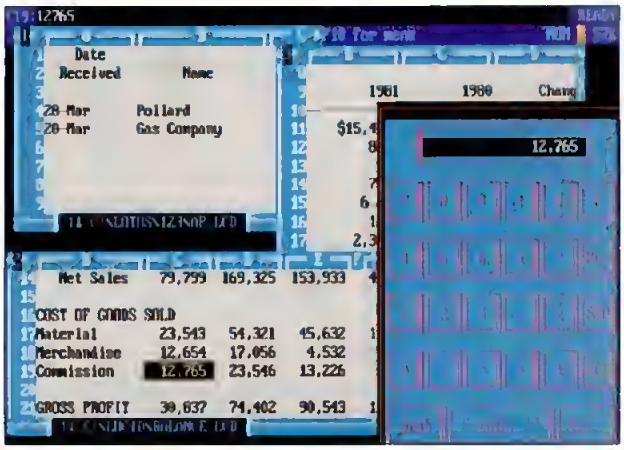
BY CRAIG STINSON

When the first version of Personal Computer Support Group's *Lucid 3-D* appeared just over a year ago, First Looks praised it as an "inspired little spreadsheet that solves all the usual problems in most unusual ways." In its new garments, as Version 2.0 from Dac Software, it is still inspired but rather less "little," and it now solves some problems it ignored before.

The essentials are unchanged: *Lucid 3-D* remains a budget-priced, memory-efficient, mouse-hospitable pop-up spreadsheet that offers linking, built-in auditing, a rich macro language, and an assortment of other conveniences. But Version 2.0 sports 15 major improvements, according to Dac Software, the company that took the product over in 1988.

In TSR mode, the original *Lucid* handled only about 60K of data at a time. You could go

(continued on next page)



Lucid 3-D *lets you simultaneously view up to nine spreadsheets and an optional calculator. Calculator values can be plugged directly into worksheet cells.*

HANDS-ON INDEX

QUICKC 2.0
Adds sharp new interface, hypertext help 36

VOLKSWRITER 4
Polices writing skills with integrated grammar checker 38

ACTOR 1.2
Microsoft Windows programming helper..... 43

VP TOOLBOX
Helps you manage, browse *Ventura Publisher* files and style sheets 46

SLED
Embeds graphics into text-based applications..... 46

PC-MIX
DOS multitasking made easy, affordable 48

THE HEAVY-DUTY WORD PROCESSOR
Word processing for *Lotus 1-2-3* aficionados..... 56

Lucid 3-D

(continued from page 33)

beynnd that, but only hy taking advantage of the program's worksheet-linking capahility. Nnw you can build much larger structures with as much or as little modularization as you like.

Lucid 3-D 2.0, in either its standalone mode or as a TSR, supports up to 8MB of expanded memory. If you don't have an EMS board, you can still take advantage of a command-line switch tn increase *Lucid*'s capacity in pnp-up mnde. The cnmmand-line switch also lets you restrict the maximum worksheet size to as little as 32K, making *Lucid* one of the few spreadsheet programs ahle to run on 256K machines. Since the program itself cnnsumes only 141K (compared with about 200K for *Lotus 1-2-3*, Release 2, and much mnre than that fnr *Quattro*, *SuperCalc 5*, and *Microsoft Excel*), you can nnw build pretty hefty worksheets without having to hreak them up into linked modules.

Of course, if you want to think mndular, *Lucid 3-D* is glad tn accommodate and encourage you. Wnrksheet linking is *Lucid*'s last name, though the 3-D moniker is misleading. *Lucid* supports separate-but-linked sheets in the manner nf *Excel*, nnt the multipage three-dimensionality offered hy *SuperCalc 5* and the fnrthcnming *Lotus 1-2-3*, Release 3.

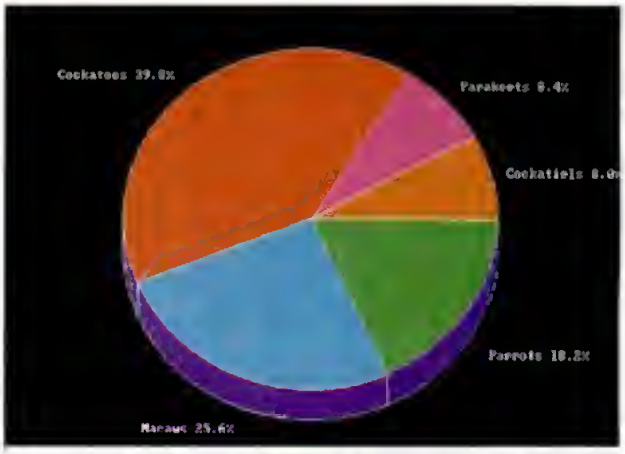
Version 2.0 improves the linking of the original in several ways. Befnre, when ynu made an external reference, *Lucid* cleared the calling worksheet from the screen to show the supporting wnrksheet. Now ynu have the option of seeing both at once—you can keep as many as nine linked or unlinked worksheets visihle at any time. Ynu'll also find a new one-step procedure for linking a range in one wnrksheet to a range in another, as well as an auditing option that shows all current linkages in a tree diagram.

While these improvements are convenient, the change that will matter most to heavy-duty linkers concerns recalculation. At recalc time, *Lucid* now evaluates each sheet in a chain only once, regardless of how many times each sheet is referenced. In a complex weh nf interrelated files, the time savings hrought about by this enhancement can be dramatic.

The nld *Lucid* was strictly a spreadsheet: it did neither datahases nnr graphics. The new one includes GX, a separate 123K TSR graphing utility. With GX installed, *Lucid* offers seven basic graph types, including some with three-dimensinnal perspective views.

The inclusion of graphics does not alter *Lucid*'s profile as a lean and mean spreadsheet. If memory is at a premium, you can leave the graphics behind. Or you can simply pop out tn DOS when you need a chart, invoke GX, then return to DOS and unload GX when you've finished graphing.

Lucid 3-D's new TSR graphics utility offers seven types of graphs. The utility occupies 123K but can be left unloaded to conserve memory.



Lucid 3-D generates graphs in three-dimensional perspective. Options allow you to change a graph's orientation and transpose data series and points.

Lucid 2.0 takes a similar plug/unplug approach to data file cnnversion. Bidirectional translatinn utilities are now provided for *1-2-3*, *dBASE II* and *III*, comma-delimited ASCII, and files created by *Dac Easy Accounting*. Each is a standalone TSR consuming ahout 10K. With the appropriate utility installed, you can load and save foreign data files just hy specifying the appropriate extension: .WK1 for *1-2-3*, Release 2, fnr example.

The ability to read and write *1-2-3* files directly is a plus, but it doesn't remedy a major shortcoming nf *Lucid 3-D:* the program isn't very compatible with the industry-standard spreadsheet program. *Lucid* has neither datahase functinns nnr string functions, so *1-2-3* cells that use those functions contain the text Cannot Cnnvert nn arrival in *Lucid*. *Lotus 1-2-3* macros are ported over as useless string literals. Oddly ennugh, the translate utility doesn't even bother to preserve the numeric and date formats of your *1-2-3* cells, even though *Lucid* nffers all nf *1-2-3*'s formatting optinns and more.

The nther major area nf improvement in this release is in the macro language and development envirnnment. Augmenting an already rich set, the language nffers a few new looping and conditinnal directives, and a compiler has been added tn the environment.

Serious programmers will appreciate the cnmpiler, even though the entire *Lucid* macro language is availahle through menus and keystroke recording. The cnmpiler lets you add commentary tn ynur macros using your favorite editor, and includes a C-like preprncessor with which you can mold and extend the language.

Fnr spreadsheet work that does not require database functionality or a high degree of compatibility with *1-2-3*, *Lucid 3-D* remains an extremely appealing product. It's fast, easy on memory, and inexpensive. Incomplete cnmpatibility with *1-2-3* has histnrically been the kiss of death for innnvative spreadsheet programs. *Lucid 3-D* 2.0 deserves to be the exception. PC

PC MAGAZINE FACT FILE

***Lucid 3-D*, Version 2.0**
Dac Software Inc.
17950 Preston Rd., #800
Dallas, TX 75252
(215) 248-0205
List Price: $99.95 (upgrade from Version 1, $35).
Requires: 256K RAM, DOS 2.0 or later. Hard disk recommended.
In Short: Upgrade adds needed features such as graphics, larger models, and direct *Lotus 1-2-3* file import/export to this innovative pop-up spreadsheet. Not copy protected.

CIRCLE 448 ON READER SERVICE CARD

Zenith Z-386/33

(continued from page 33)

The Model 150 comes equipped with an 18-millisecond 150MB hard disk ($11,490), while the Model 320's 320MB hard disk ($13,499) boasts an average access time of 16 ms.

An ESDI controller with a 10-megabyte-per-second data transfer rate and 1:1 interleave further boosts the speed of these already fast drives. Despite the relatively poor showing on the DOS File Access benchmark test, the 16-ms. CDC drive in the Model 320 evaluation unit performed slightly faster than rated.

In another move to enhance speed, Zenith provides a combination of software and firmware—whimsically named Slushware—that shadows the 8-bit ROM into 32-bit RAM. For floating-point support, there's a socket for an 80387 or a Weitek 3167.

SuperSet Slots

Leaving behind the passive backplane architecture of earlier Zenith machines, the Z-386/33's motherboard looks much the same as most other desktop systems—with the exception of the expansion slots. Four out of the seven are Zenith's own 32-bit SuperSet slots, in which you can plug 8-, 16-, or 32-bit cards; the system automatically senses a card's frequency and adjusts the bus speed accordingly.

One of the SuperSet slots is sacrificed to an I/O card with one parallel and two serial ports. The second serial port uses one of the machine's three punchouts.

In the Models 150 and 320, a Zenith Z-549 16-bit VGA card occupies one of the three remaining 16-bit slots. The benchmark test results for the card in our Model 320 evaluation unit were only average, but Zenith is planning to bundle a Video 7 VGA card with the machine for buyers desiring better video performance.

On the Model 320, the half-height floppy disk drive and full-height hard disk leave only two drive bays available for expansion. The disk controller supports up to two floppy disk drives and two hard disk drives. An excellent setup program accessible with the Ctrl-Alt-Ins key combination allows you to configure your system easily. Through one on-screen menu not only are you able to specify your hardware—memory, drives, and video—but you can also set a power-on password or choose to bypass the A: drive automatically when booting your system.

The SETUP program also lets you determine how many layers deep—between 0 and 16—your posted-write buffer will be. The Z-386/33 can operate at three speeds that you specify with the SETUP program: Slow (AT compatible), Fast, or Smart. Zenith bundles *Microsoft Windows/386* and its own incarnation of DOS, MS-DOS 3.3 Plus, with the Z-386/33.

The combination of a 33-MHz chip and the SuperSet slot architecture make the Zenith Z-386/33 a powerful and flexible desktop workstation.

FACT FILE

Zenith Z-386/33
Zenith Data Systems
1000 Milwaukee Ave.
Glenview, IL 60025
(800) 842-9000, ext. 1
List Price: Model 1, $7,999; Model 150, $11,490; Model 320, $13,499. MS-OS/2, $339.
In Short: A solid 33-MHz desktop system whose price and performance rival that of good 25-MHz machines.

CIRCLE 450 ON READER SERVICE CARD

MS-OS/2 1.1 will also be available for $339. The system comes with a 1-year warranty.

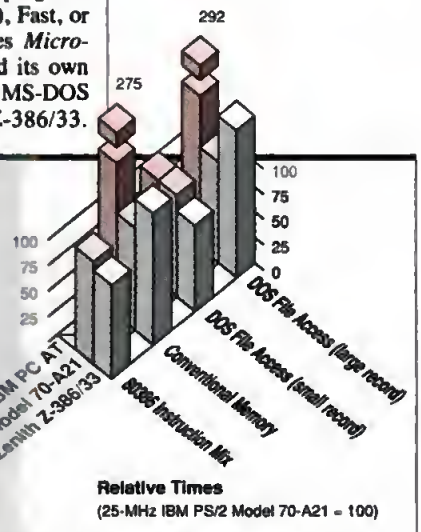
If you're looking for the fastest machine money can buy, wait to see what the competition has to offer: the performance of our evaluation unit was disappointing for a 33-MHz machine. On the other hand, if you are considering a high-end 25-MHz box, the Zenith Z-386/33's price and performance may make it a smarter buy. PC

Benchmark Tests: Zenith Z-386/33 vs. 8-MHz IBM PC AT and 25-MHz IBM PS/2 Model 70-A21

While the Zenith Z-386/33's 33-MHz processor gives it the edge on the Instruction Mix test, it fared poorly on the Conventional Memory test, with times slower than those of most 25-MHz machines. The standard configuration uses a relatively small memory cache (16K) and a NEC cache controller.

Performance Times (Times given in seconds)	80386 Instruction Mix	Conventional Memory	DOS File Access (small record)	DOS File Access (large record)
8-MHz IBM PC AT	N/A	0.77	72.63	19.74
25-MHz IBM PS/2 Model 70-A21	2.28	0.28	72.37	6.77
33-MHz Zenith Z-386/33	2.08	0.36	60.65	9.83

N/A—Not applicable; not an 80386 machine.



The **80386 Instruction Mix** benchmark test measures the time it takes to execute a selected series of processor-intensive tasks. The test program uses 80386 instruction code. These instructions are a subset of the total processor instruction set. The 80386 Instruction Mix implements a number of 32-bit operations. In the 80386 processor these become single instructions, whereas in the 8086 and 80286 versions of the benchmark test they remain multiple instructions.

The **Conventional Memory** benchmark test allocates 256K of conventional memory and treats it as a series of 64-byte records. Then, 16,384 random records are read into and written from this memory. The result shown is the average of the read and write times.

The **DOS File Access** benchmark test measures the throughput rate of the disk being tested. In this case, throughput times are measured in terms of how long the disk takes to perform common DOS file-management functions. Five tasks—file creation, sequential file write, sequential file read, random file write, and random file read—are timed and the results summed.

The test is carried out for two different types of files—small-record files and large-record files—that are used by common PC applications. Files created using small records are typically used by database management programs, and large records are typically used for word processing and spreadsheet files. Loading a DOS program is also simulated by the large-record test.

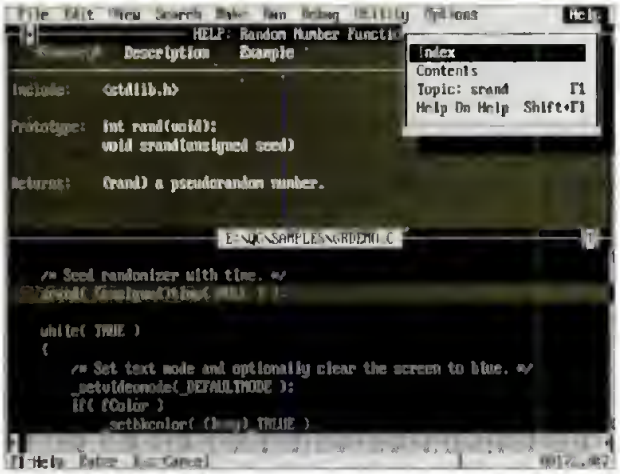
Photograph: Thom O'Connor

QuickC 2.0 Shows Off New Interface, Adds Memory Models, In-line Assembler

PC HANDS ON

BY RICHARD HALE SHAW

With QuickC 2.0, Microsoft has redefined the notion of an integrated development environment for C programmers. Sporting an improved interface, QuickC now has several features designed to appeal to the novice C programmer, and it has taken the time to consider how people will use this program—beyond the pull-down menus and other features that are intrinsic in integrated development environments. The interface is even easier to use if you have a mouse. And you can add your own entries to one of the pull-down menus. This allows you to integrate your own programs into QuickC, so you



The QuickC debugger resembles Microsoft CodeView: you can view program variables, registers, and source code as you step through your program.

addresses the needs of professional developers too.

Experienced QuickC users have long griped about its lack of support for more than one memory model. They've also stressed the need to embed in-line assembler into their C programs. QuickC 2.0 addresses both concerns. It provides support for five memory models and in-line assembly language. It includes a new set of presentation graphics libraries, and you can use it to create protected-mode programs for OS/2. Microsoft has also improved the built-in editor and debugger. And all users will enjoy the QuickC Advisor, an on-line help system that virtually eliminates the need for documentation.

I love the new QuickC interface. It behaves the way you expect it to behave, and it seems to anticipate your needs. Someone won't have to exit QuickC or load DOS to use them.

QuickC 2.0 boasts an improved graphics library with powerful presentation graphics functions. It includes routines for generating bar, column, line, and pie graphs and charts. You can also select from a variety of fonts.

Microsoft also has improved the QuickC editor. While the editor interface has not changed much, it is much closer to the editor supplied with Microsoft C 5.1 under the hood. You can configure it and make it behave like other popular program editors such as *Brief* and *Epsilon Text Editor*.

Microsoft has completely rewritten the QuickC documentation with Version 2.0. Instead of a reference and a user manual, QuickC comes with a small installation guide, the QuickC Toolkit, and a book called *C for Yourself*. The first half of this book is an excellent introduction to C for people who have programmed in other languages. It doesn't explain basic programming concepts, but it does describe how to implement and express them in C. A novice will find that it presents the full range of C topics, with chapters on functions, data types, and operators. It also includes two chapters on pointers, and all are replete with examples and explanations. The second half of *C for Yourself* covers the advanced topics that more-experienced C programmers will use, and the QuickC Toolkit covers more-technical issues such as compiling, linking, and managing function libraries.

The QuickC Advisor is without a doubt the hottest aspect of QuickC 2.0. This hypertext-based cross-referencing system lets you look up information in a structured manner (via an index or table of contents) or an unstructured manner (like "Find all references to the printf function"). Suppose you need to know what header files a particular function requires or what arguments should be passed to it. Place your cursor (or mouse pointer) on the function and select it. The help system will find the reference and display a complete summary of the function with a description and examples. If you find that you can use the example in your program, you can copy it from the help screen and paste it into your code via the editor.

The Advisor also lets you search for any reference to a word or phrase. It can repeatedly scan through the nearly 1,800 pages of disk-based documentation for the information you need. With this capability, you'll be able to leave the manuals on the shelf.

For more-advanced C programmers, Microsoft has improved the QuickC debugger. It's easier to use and includes a history function that will keep track of the steps you take during a debugging session. You can step backward through the code or rerun a series of steps. An animation facility lets you watch the debugger as it steps through the code. While I have a love-hate relationship with Microsoft CodeView (I hate its interface, but I love the results it produces), this debugger is much nicer, even if it's not nearly as powerful.

While the program claims to run in the OS/2 compatibility box (or DOS session), it seemed to have intermittent problems when I ran it (in the DOS session under OS/2 Standard Edition 1.1). Still, you can use it to generate code for OS/2's protected mode, although you can't run it in an OS/2 protected-mode session yet.

All in all, I like this compiler. Inevitably everyone will ask, How does it compare with Borland's Turbo C 2.0? That is a difficult question, and QuickC 2.0 doesn't make it any easier to answer because Microsoft has corrected many of its previous deficiencies in this version. The comparison boils down to differences in taste and style. But if you haven't looked at integrated development environments for C before, you should consider QuickC 2.0. PC

PC MAGAZINE FACT FILE

QuickC 2.0
Microsoft Corp.
16011 NE 36th Way
P.O. Box 97017
Redmond, WA 98073-9717
(206) 882-8080
List Price: $99
Requires: 512K available memory, DOS 2.1 or later. Hard disk recommended, mouse optinnal.
In Short: A powerful, integrated C development environment for programmers and novices. Boasts support for five memory models, presentation graphics library, and in-line assembler. On-line hypertext documentation eliminates the need for paper manuals.

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CIRCLE 299 ON READER SERVICE CARD

Volkswriter Adds Grammar Checking

PC HANDS ON

BY JONATHAN MATZKIN

You *can* teach old software new tricks. *Volkswriter*, from Lifetree Software, has been around for almost as long as the PC. It offers a good balance of basic performance and ease-of-use. But Version 4 adds something calculated to make users sit up and take notice: an integrated grammar checker. No other major word processor offers grammar checking as a built-in feature.

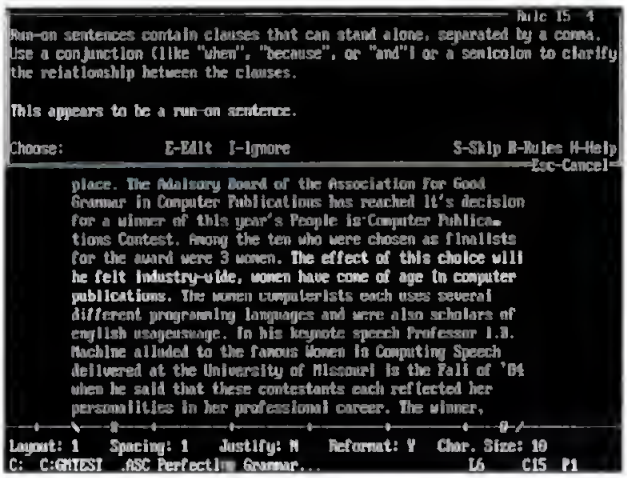
Perfect Grammar, as it is called, is the most obvious enhancement in *Volkswriter*, Version 4, but it's far from the only change. The other upgrades are in keeping with *Volkswriter*'s blend of strong functionality and a simple interface.

Lifetree has always made ease-of-use a selling point for *Volkswriter*, and the new "point-and-pick" file-selection screen is in keeping with that philosophy. When you boot up *Volkswriter 4*, the package presents a screen divided into two windows. The top of the screen is a simple menu that lists many of the basic commands for getting or saving documents. You can also access style sheets from this menu.

The bottom half of the screen lists the files in your predesignated document directory. You simply point-and-shoot to load a document or type the name of a different directory. The window displays the contents of the new directory you have selected. Simply typing a filespec (including path) will retrieve a file from anywhere on your disk. Files are sorted by creation date in reverse chronological order, so your most recently created files appear in the upper left of the document selection screen.

Beyond file selection, *Volkswriter 4* offers some other important enhancements. *Volkswriter 4* maintains full compatibility with Lifetree's previous *Volkswriter 3* and *Total Word* software while addressing some of the shortcomings of earlier versions. We complained about the lack of an "undelete" capability in our last review of *Volkswriter 3* ("Fast, Flexible, and Forward-looking," *PC Magazine*, February 29, 1988), and Version 4 adds that feature.

Printer support has also been beefed up to include drivers for PostScript printers. An envelope-printing menu lets you specify top and left margins as well as line spacing. Landscape envelope printing on laser printers is also supported. And you can specify a range of pages and a number of copies to print.



Volkswriter 4's integral grammar-checker will catch many common writing faults, such as this run-on, but it won't replace human editors.

Perfect Grammar: Almost An Editor

The big news about *Volkswriter 4* is that Lifetree has included a full-featured grammar and style checker in the word processor. *Perfect Grammar* can be called by simply tapping the F2 key from anywhere in a document. It suggests changes intended to make your writing reflect rules of standard business English.

Because it is so tightly integrated with the word processor, *Perfect Grammar* has one obvious advantage over separate grammar-checking packages. You don't have to exit the word processor and run other software in order to check your document.

Perfect Grammar has an impressive lineage; it is descended from *CorrecText*, an ambitious grammar checker developed by Houghton Mifflin to run on mini and mainframe systems.

In actual practice, *Perfect Grammar* displays many of the shortcomings of standalone packages such as *Grammatik III* and *RightWriter*. The sentence "We need to have a meeting, the car is in the garage" is identified as a run-on sentence. *Perfect Grammar* displays information about run-ons and how to correct them. But eliminating the comma between the two clauses causes the software to skip over it without comment. Still, that's better than either *Grammatik III* or *RightWriter* did with the same sentence. Neither program objected to the run-on whether or not it had a comma.

Perfect Grammar seems to do about as well as the other PC-based packages in most other areas. It doesn't seem likely that a sophisticated package designed to run on larger systems can easily be brought down to the PC with all its power intact, and *Perfect Grammar* is subject to that limitation.

Obviously, some additional compromises had to be made in the size of the software in order to allow it to be simultaneously resident with the word processor. As it is, the combination of the two requires a full 640K RAM to run. Lifetree wisely gives you the option of loading the word processor alone.

While PC-based grammar checkers won't "edit" your documents in the same way that a human being would, they do catch many mistakes. *Perfect Grammar* is an extremely convenient way of passing your work through this limited filter without having to leave your work environment.—**Jonathan Matzkin**

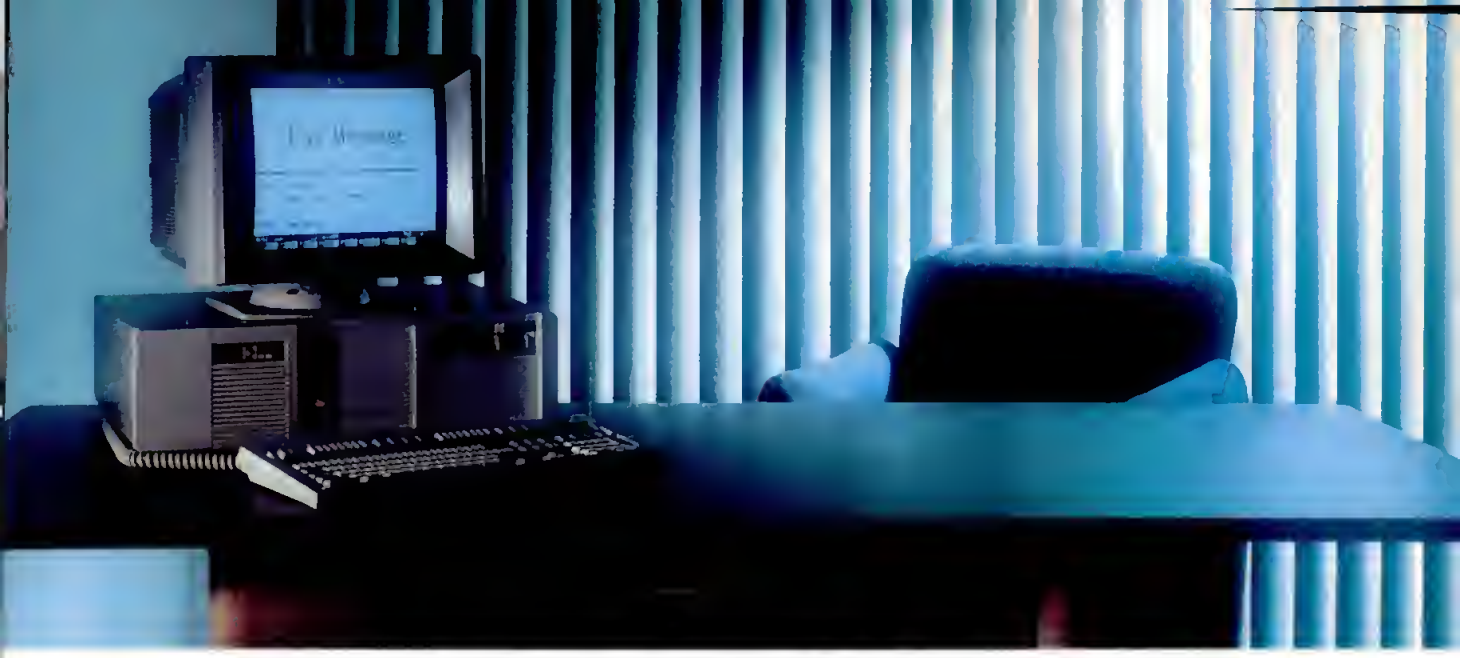
A word-count feature is another welcome addition, and Version 4 also offers a time- and date-stamp feature. Simply tap Alt-D and a window pops up with the current time and date in every format you could possibly imagine. A single keystroke inserts the time and/or date at the current cursor position.

Volkswriter doesn't offer the quasi–desktop publishing features that many other word processors have recently sprouted. Version 4 is aimed squarely at the same corporate and personal users who have made earlier versions a familiar sight on many desktops. The new enhancements improve the tool while keeping it simple to learn and use. PC

PC MAGAZINE FACT FILE

Volkswriter 4
Lifetree Software Inc.
411 Pacific St.
Monterey, CA 93940
(800) 543-3873
(800) 831-8733 (in Calif.)
Requires: 640K RAM, DOS 2.0 or later.
List Price: $199
In Short: Adds file manager and grammar checking to this solid, easy-to-use word processor. Not copy protected.

CIRCLE 451 ON READER SERVICE CARD



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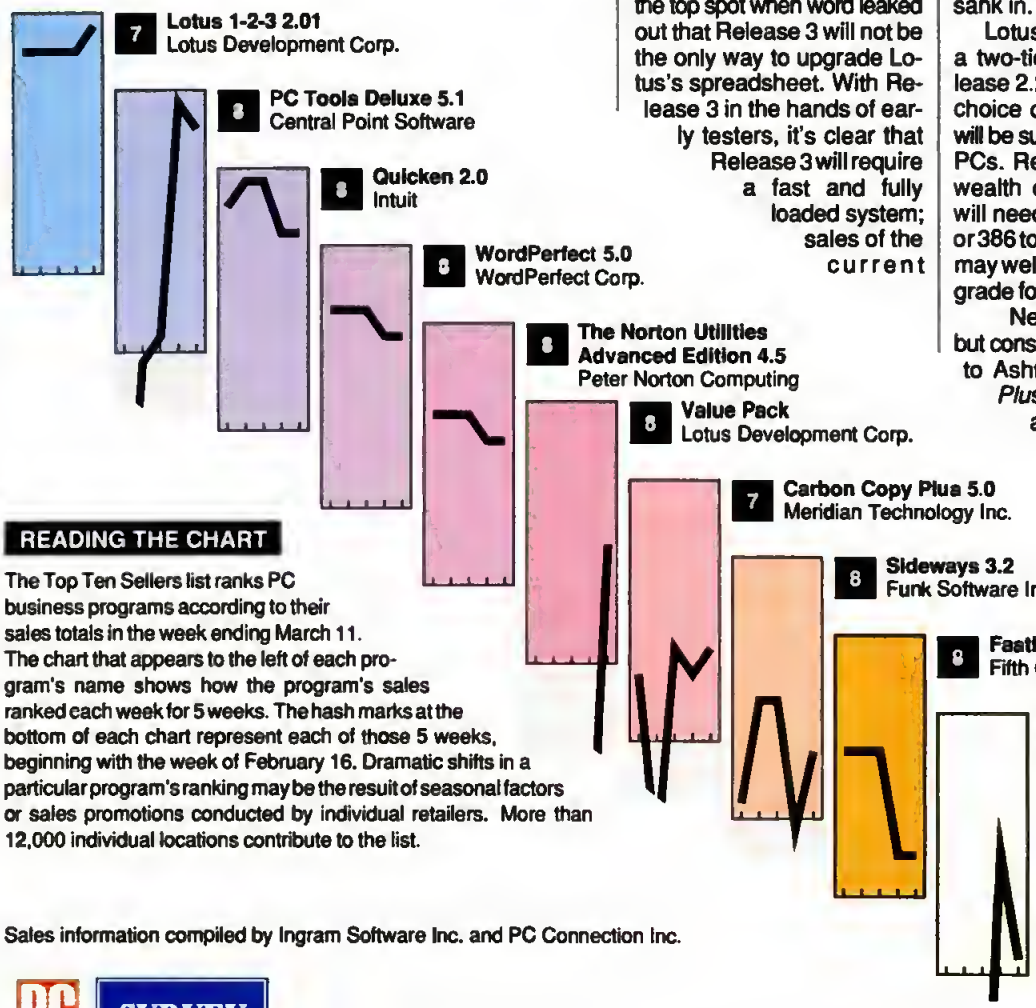
PC MAGAZINE PIPELINE

TOP TEN SELLERS — A 5-Week History



Lotus 1-2-3 bounced back into the top spot when word leaked out that Release 3 will not be the only way to upgrade Lotus's spreadsheet. With Release 3 in the hands of early testers, it's clear that Release 3 will require a fast and fully loaded system; sales of the current version started to sag as that sank in.

Lotus has now decided on a two-tiered approach. Release 2.2 will have a modest choice of new features and will be suitable for 8088-based PCs. Release 3 will have a wealth of new features but will need the speed of a 286 or 386 to perform well—and it may well require an OS/2 upgrade for peak performance.

New features are nice, but consider what's happened to Ashton-Tate: *dBASE III Plus* is still in the Top Ten and *dBASE IV* is trailing at number 12.

READING THE CHART

The Top Ten Sellers list ranks PC business programs according to their sales totals in the week ending March 11. The chart that appears to the left of each program's name shows how the program's sales ranked each week for 5 weeks. The hash marks at the bottom of each chart represent each of those 5 weeks, beginning with the week of February 16. Dramatic shifts in a particular program's ranking may be the result of seasonal factors or sales promotions conducted by individual retailers. More than 12,000 individual locations contribute to the list.

Sales information compiled by Ingram Software Inc. and PC Connection Inc.

Rankings are based on net sales by unit; returns are subtracted from gross sales.

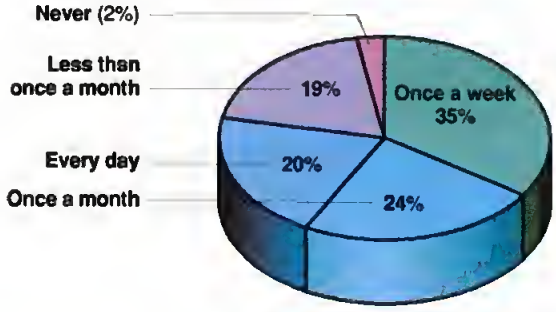
PC MagNet SURVEY

How often do you back up?

The continued success of Fifth Generation Systems' *Fastback Plus* and other backup programs (see Top Ten Sellers) proves that many people understand the importance of regular backups.

So we asked callers to PC MagNet, How often is enough? The results ought to give pause to those of us who haven't been taking the time to protect our files.

More than 1,300 callers answered the survey.



THE 486: MORE OF THE SAME, FASTER

After months of speculation, Intel has finally unveiled the specs on its next-generation PC microprocessor, the 80486. The chip is months away from large-scale production, and computers based on the 486 won't go on sale until the end of this year—at the earliest.

Right now, it looks as though those who speculated that the chip portends thunderous changes throughout personal computing will be proven wrong. Those who had the more modest expectation of finding a smooth path to higher performance and easier multitasking will not be disappointed.

The 486 is completely code compatible with the 386—there are no new modes and few additional instructions. The 286 protected mode and virtual 86 mode will work flawlessly. DOS and OS/2 applications will run unchanged.

Still, there's plenty of flashy technology to be found among the 1,180,285 transistors in the 32-bit processor.

Intel rolled all of the math coprocessing features of the 80387 inside the CPU—that doesn't just cut down on part costs, it dramatically improves floating-point calculations, since the extra hand-shaking and communicating code that's been needed for use of the 387 (and the earlier 287 and 8087) is avoided.

Another big performance gain will come from an integrated 8K data cache inside the 486. Intel's engineers have employed a four-way set associative logic that, they claim, will have a better than 90 percent hit rate when retrieving the contents of RAM. In addition to the performance boost, the cache will be a cost saver: it saves on the amount of memory system designers are tempted to devote to an on-board cache

The four-way set associative cache means that four distinct buffers are maintained. Algorithms choose the best distribution of saved addresses for the cache. In contrast, the memory caches used in today's 386 PCs use a linear, direct-mapped logic.

Bus Snooping

The chip was designed to work smoothly with several processors on the same bus, and so the cache includes a bus snooping technique that monitors changes to memory locations. As a result, two or three 486s could be reading from and writing to the same bank of RAM—the ideal setup for running OS/2 applications that are sharing files.

In fact, Microsoft's OS/2 engineers had plenty of advice for Intel's design team. As a result, 386 instructions that affect semaphores were optimized in the 486. Down the road, you're likely to see OS/2 shipping with two sets of dynamic-link libraries, one for each processor. While the 486 will run such 286/386-specific code, the improved semaphore handling of the 486 will give a performance boost when running DLLs that take advantage of the changes.

The processor is expected to cost computer makers about three times what a 386 costs ($950 versus $300), so the premium for a 486 PC will not be as severe as some expected.

The first chips will have 25-MHz clock speeds and, several months later, a 33-MHz version will ship. Although those speeds match the fastest 386s now, Intel believes that the 1-micron, high-speed CMOS design of the 486 will carry it far ahead—up to 50 and 60 MHz in the early '90s.

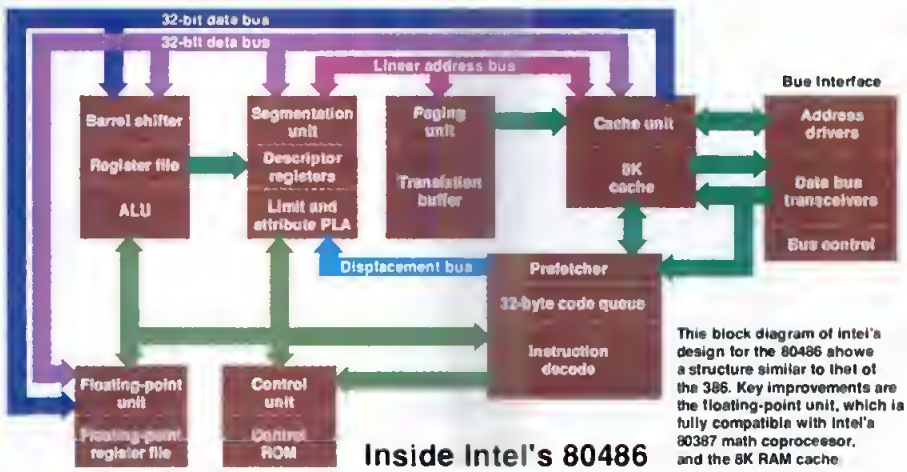
No Quick Switch

Clearly, a 486 transplant could be used to pump a little more speed out of current 386 PC designs; although the 168-pin 486 is not pin compatible with the 132-pin 386, adapter cards could be created. But since the 486 design sets new demands on bus specifications, little would be gained. The new processor can handle fast burst-mode transfers that current bus designs won't provide.

The 486's true potential is a server in which three or more processors each run separate multitasking applications, sharing memory and storage.

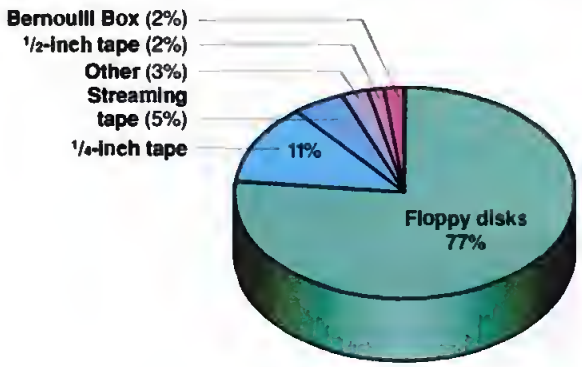
But there's nothing to stop you from buying this latest toy simply to pump the last bit of juice out of your biggest, toughest spreadsheet.

—Gus Venditto



Inside Intel's 80486

This block diagram of Intel's design for the 80486 shows a structure similar to that of the 386. Key improvements are the floating-point unit, which is fully compatible with Intel's 80387 math coprocessor, and the 8K RAM cache



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Actor: Object-oriented Development Tool Lessens MS Windows Programming Load

PC HANDS ON

BY ROBERT L. HUMMEL

Simply put, *Actor* is a programming environment that helps you design *Microsoft Windows* applications. A programmer's tool rather than an application generator, it won't do your thinking for you, but it can make programming for *Windows* easier.

Instead of separating the active programming instructions from the passive data, *Actor* integrates the two into a unit called an object. Objects are easily explained as smart data. Consider a dancer, a singer, and a piano player. Without knowing anything about which is which, you can issue the command "Perform!" The command itself is ambiguous, but because the performers (the data) are smart, they each know what to do.

Application development in *Actor* still requires program design, coding, and generation. First, you specify the objects needed by your program. Every object is simply a specific instance of a general, descriptive class. A class is somewhat analogous to a data type.

A large number of classes, many relating specifically to *Windows*, are available in the *Actor* environment. These can be used without any programming effort. If you can't find one that's suitable, you can modify an existing one by a process called inheritance. This ability makes it easy and desirable to reuse code.

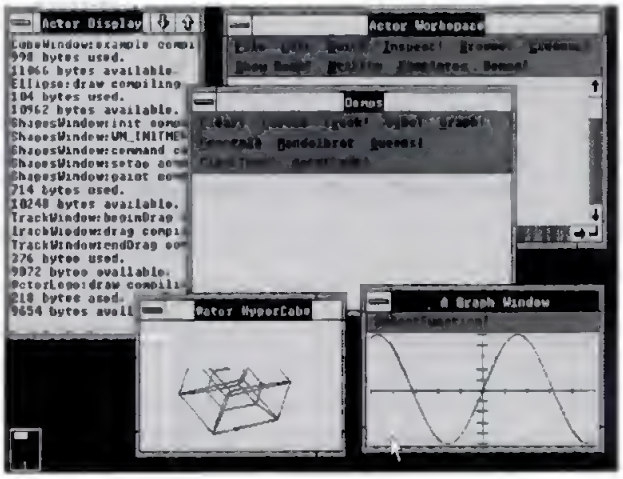
Once you define the objects, you then write the routines, or methods, that the objects will execute as they receive messages. For example, if you defined an object called TableLamp and decide it should act on the messages TurnOn and TurnOff, you would write two methods to implement those actions. Despite the strangeness of the means, you still wind up with the same end.

Actor is an interpreter. This makes programming highly interactive and leads to rapid application development. But, when complete, your application will run only under *Actor*. If your goal is to produce a standalone version that will run under *Windows*, you must undertake a conversion process.

Creating a standalone application means taking the generic *Actor* runtime kernel, adding specific classes and methods you need, and removing those you don't. After this editing, two files are produced: an .EXE file that launches the application and an .IMA file that is really a runtime subset of the *Actor* environment. When executed, your finished program looks and runs like any other *Windows* application.

Actor 1.2 contains several improvements and changes from the previous version. It now works only with *Windows/286* and *Windows/386*, Version 2.1 and later, but it gives programmers full access to all *Windows* 2. *x* functions, messages, styles, and resources. Overall performance is improved through the efficient use of expanded memory, if available.

The Debug and Browser tools have been improved by adding command shortcuts and scrolling improvements. Some of the biggest complaints about the environment have also been addressed. Fatal errors caused by using an incorrect number of arguments in a *Windows* function call or making a call to an invalid window have been eliminated.



Actor's ability to display several programs while maintaining control of the environment makes complex programming tasks easier.

The ease by which programmability (such as with a macro or batch language) can be included in your application is a major improvement. And despite the additional functionality and overhead of running under *Microsoft Windows*, *Actor* performance remains quite acceptable.

Interfacing with C and *Windows* routines has been made easier by the addition of a new *Actor* class, CStruct. Three new facilities permit low-level programming, including physical memory access, hardware I/O, and software interrupts.

The first step to using *Actor* effectively is to understand object-oriented programming. If you've never used objects before, it will probably take you twice as long to learn *Actor* as another linear language. But the program's 600-page-plus manual provides an excellent tutorial on object-oriented programming and, overall, I believe you could turn out your first *Windows* application sooner than if you learned to program for *Windows* in C.

Writing programs in *Actor* has a different feel than with traditional languages. Your aim is to minimize program complexity and thus produce easily maintained code. But *Actor* can camouflage errors that occur at the hardware level or in the operating system routines. When deciding whether or not to use *Actor*, it's important to know what's more important to you: understanding what *Windows* is doing at the hardware level or getting an application written quickly.

Who can benefit most from *Actor*? As more large firms develop in-house applications designed to run under the *Windows* environment, they'll find *Actor* is a quick way to start turning out applications. I would recommend *Actor* to anyone with an interest in programming for *Windows*. PC

PC MAGAZINE FACT FILE

Actor, Version 1.2
The Whitewater Group Inc.
Technology Innovation Center
906 University Pl.
Evanston, IL 60201
(312) 491-2370
List Price: $495
Requires: 640K RAM, hard disk, Microsoft Mouse or other *Windows*-compatible pointing device, *Windows*-compatible graphics display and adapter, *Windows/286* or *Windows/386* 2.1 or later, DOS 3.0 or later.
In Short: An object-oriented program development environment for producing *Windows* applications.

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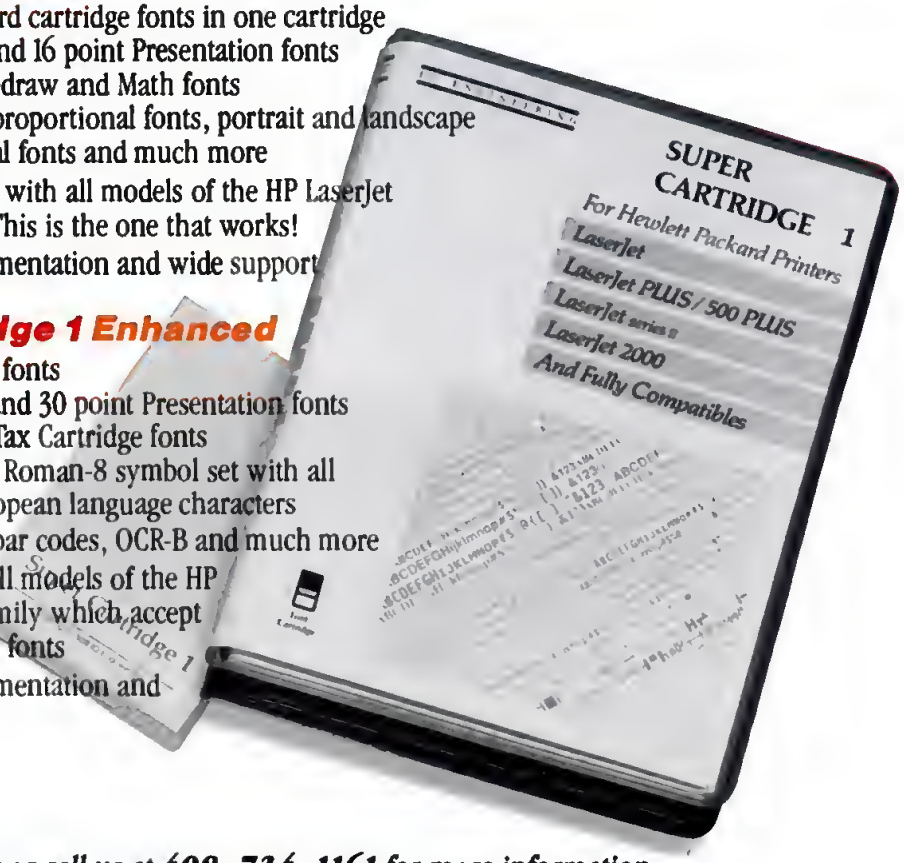

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CIRCLE 186 ON READER SERVICE CARD

VP Toolbox: The Easy Way to Manage Ventura Publisher Files and Style Sheets

PC HANDS ON

BY EDWARD MENDELSON

"*Ventura* Secrets Exposed" should be the headline on every copy of *VP Toolbox*, Version 3.0. This $99 file manager for *Ventura Publisher* lets you easily catalog, display, or rearrange the files in *Ventura* chapters, and view, compare, or alter the contents of *Ventura* style sheets. In *Ventura* you perform some—not all—of these functions, but only after hours of tedious mouse-maneuvers in a dozen disconnected menus.

VP Toolbox runs from the DOS command line. You use arrow keys or a mouse to access screens that list the files included in your publications and the contents of the associated style sheets. The program lets you maintain a catalog of information about chapters and style sheets in any directory on your disk, so you get quick access to information that's almost impossible to find within *Ventura*. You can view or print lists of text, line art, and image files included in any chapter. And you can automatically display word counts for all text files, or peek at the opening screen of each.

VP Toolbox is even more impressive when managing style sheets. A keystroke brings up a summary listing of each tag in a style sheet. Another keystroke zooms in on the full contents of any tag. You can print summary or detailed reports of style sheets, or generate a file to print from *Ventura* that contains samples of the font, spacing, and alignment of each tag. You can also determine which tags are actually used in any chapter and compare two style sheets for similarities and differences.

The $149 Advanced Edition and Network Edition of *VP Toolbox* let you modify all the tags in a style sheet that use the same font, point size, line spacing, or other attributes. Instead of searching through a dozen tags to make sure you've changed every instance of 10-point Helvetica to 11-point Futura, you can make the change with a few keystrokes. With the Advanced and Network Editions you can also generate a *dBASE* or comma-delimited file from the program's catalog of style sheets and chapters.

VP Toolbox isn't perfect. It tends to drop you abruptly into the opening menu when you want to get further work done in a deeper menu. And it needs a function that lets you search for a text string in all the files in a chapter or publication. But no other program makes it as easy to harness the multitude of files that *Ventura* can print. PC

List Price: *VP Toolbox*, Version 3.0, $99; Advanced and Network Editions, $149 each. **Requires:** 256K RAM, DOS 2.1 or later. Not copy protected. SNA Inc., P.O. Box 3662, Princeton, NJ 08543; (609) 799-9605.

CIRCLE **446** ON READER SERVICE CARD

SLEd Adds Graphics to Text-based Applications

PC HANDS ON

BY EDWARD MENDELSON

You have a choice of two ways to add a logo or signature in your laser-printed documents. If you're lucky enough to use a word processor that handles graphics, you can import the digitized image and then go out and get a cup of coffee while the image prints slowly in graphics mode. Or you can use *SLEd* to convert the graphics image into a soft font, download it, and print it as quickly as if it were text.

VS Software's $295 *SLEd Image Processor* is a graphics editor designed solely for laser printers and mostly to prepare graphics for word processing and other text-based applications. Although *SLEd* lets you scan, create, import, resize, and edit .PCX and .IMG files like any other graphics editor, you're better off with almost anything from *PC Paintbrush* to *Micrografx Designer* if all you need to do is edit and print graphics.

You need *SLEd* when you want to use graphics in applications that don't know anything about graphics, or that include graphics only as an awkward add-on. *SLEd* takes a graphics image and slices it into pieces the size of the letters in a standard Courier font. You can then print the image in one of two ways.

The complicated way is to switch to this new font in your application and then type the letters of the alphabet in a block. *SLEd* specifies the length and width of the block when it converts the graphic. You adjust the location of the image just as you would text.

The simpler way, which works only with HP LaserJets and compatibles, is to use *SLEd* in conjunction with its 10K TSR. You simply type the name of the converted soft font between two caret characters in your document.

The TSR, which monitors output to the printer, detects the filename and substitutes the characters in the converted font instead.

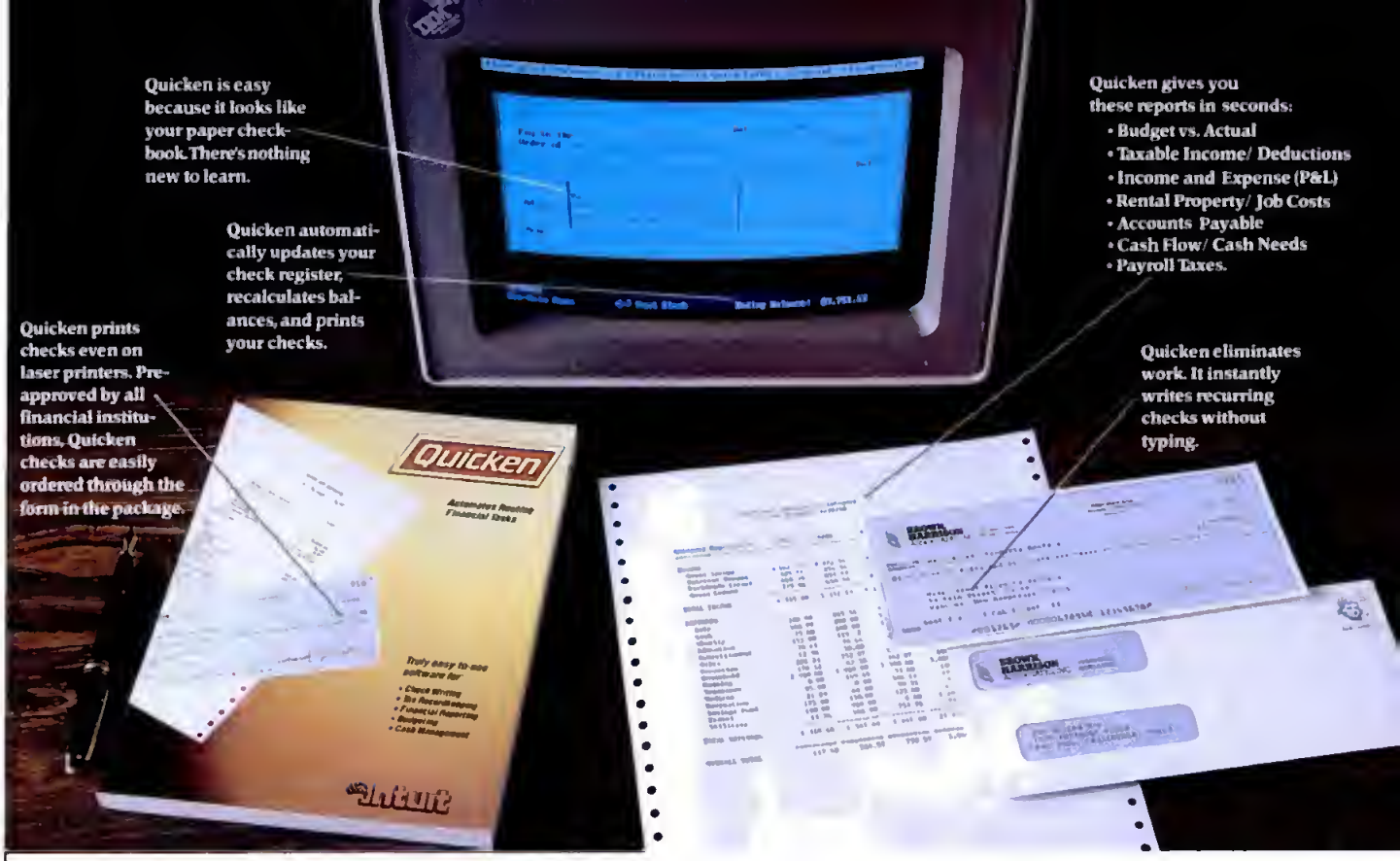
SLEd also makes it easy to integrate text into graphics. Using any soft font stored on your disk, you can superimpose text over existing images. You can't modify individual letters as easily as you can with high-end graphics programs like *Corel Draw!*, but you can use the results in any application.

The package comes with two soft fonts and a disk of decorative border patterns, along with a few scraps of clip art. You can send images to VS Software to be digitized for $25 each ($50 with touch-up), and every registered user gets one digitized image free. The order form has room for a signature as imposing as John Hancock's. PC

List Price: *SLEd Image Processor*, $295. **Requires:** 512K RAM; hard disk; graphics display; HP, Canon, Ricoh, or Cordata laser printer. Mouse or tablet recommended. Not copy protected. VS Software, 209 W. 2nd St., P.O. Box 6158, Little Rock, AR 72216; (501) 376-2084.

CIRCLE **445** ON READER SERVICE CARD

SLEd lets you enter text into a graphic screen and then copy it as white-on-black text into any part of the image.



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Paul B. Ross
January 17, 1989
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Bill Howard, Executive Editor
PC Magazine, December 27, 1988

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PC05B89

Collage Plus Pops Up over Windows, Ventura Publisher To Capture and Manage .PCX Files

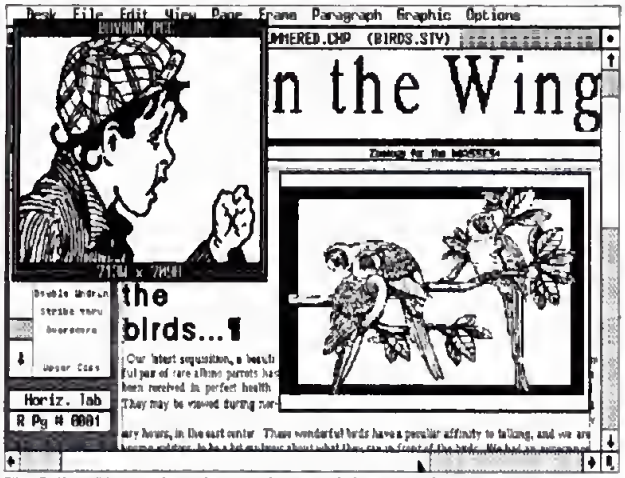
PC HANDS ON

BY EDWARD MENDELSON

Collage Plus disobeys all the rules.

Memory-resident programs aren't supposed to be able to pop up over the graphics screens of *Microsoft Windows* and *Ventura Publisher*, much less capture *Windows* and *Ventura* screens. To the amazement of everyone who sees it, Inner Media's $89.95 set of desktop publishing utilities does exactly that.

When you need to glance through a dozen .PCX files to find the one you want to import into *PageMaker*, *Ventura*, or other applications, *Collage Plus* pops up in the corner of the screen and opens a small window for viewing any .PCX or .PCC file on-disk. If you need to see more detail, you can blow up any portion of the image to fill the window.



The Collage Plus *window, shown in the upper-left portion of the* Ventura Publisher *screen, can pop up over nearly any application to view .PCX files.*

That little window opens onto many interesting possibilities. *Capture Plus* also lets you capture screens. You can adjust the color palette of the application's screen and then capture the screen as a .PCX file. And you can choose whether to save the screen in color or, for desktop-publishing, in gray-scale or two-color black-and-white format. Nine different .PCX formats are accessible from the menu. Text screens can be saved as text files and edited in any word processor.

The pop-up utility comes on-disk in three different sizes and capabilities to suit different memory requirements. Any of them can be forced to store most of its code in expanded memory, leaving only 7K in DOS.

The other half of *Collage Plus* is a full-screen nonresident viewing program that lets you examine all or part of any .PCX file and rename or delete it. You don't have to load the TSR program to use this viewer, but you can use the TSR to convert color images into monochrome by displaying them in the full-screen viewer and then capturing them and converting them with the TSR.

You may have to juggle the loading order of any existing TSRs to make *Collage Plus* work smoothly with them, but the result is worth the initial effort. Afterwards, you'll find that using graphics images in desktop publishing suddenly stopped being a headache. PC

List Price: Collage Plus, $89.95. **Requires:** 256K RAM, DOS 2.0 or later. Not copy protected. Inner Media, 60 Plain Rd., Hollis, NH 03049; (603) 465-3216.

CIRCLE 443 ON READER SERVICE CARD

PC-MIX: DOS Multitasking Made Simple

PC HANDS ON

BY BARRY SIMON

Multitasking under DOS is a precarious undertaking at best: setting up the multitasker is not for the faint of heart, and once you're up and running, things don't always work the way they should.

Proware hopes to change all that with its $49.95 DOS multitasker, *PC-MIX*. The idea behind *PC-MIX* is a good one: sacrifice some of the sophistication of multitaskers like *DESQview* for ease of setup and use. Alas, *PC-MIX* may sacrifice too much sophistication to be truly useful to most users.

To keep the multitasking down to a manageable level, *PC-MIX* lets you run only three partitions. The menu-driven configuration program requires only that you assign a priority to each partition and specify how much memory each partition can use.

Once up and running, each of the three partitions occupies the full screen. *MIX* avoids the problems other multitaskers have with graphics by not allowing you to run graphics in the background at all. And if you run a graphics program in the foreground, all background tasks are frozen.

If you have EMS 4.0 swappable memory below 640K, each partition can be as large as the amount of memory you have before *MIX* loads minus about 30K for *MIX* itself—in the neighborhood of 500K. But if you don't have the swappable EMS memory, the sum of your partitions is limited to this same size—less RAM than DOS normally allows you for a single application.

Another caveat: programs that write directly to the screen (most of my applications do) will bleed through to the foreground when running as background tasks unless you follow a special setup treatment. The special treatment involves loading the programs via a special batch file. On monochrome systems, programs loaded this way are suspended when in the background. On color systems, you are limited to one such program in the background rather than two. *MIX* also has problems with applications that use multiple pages of video display memory, such as Turbo Pascal programs and *Brief*.

Running a communications program in the background was a shaky experience. I did succeed some of the time, but I crashed often while downloading files. Proware conjectured that this could have something to do with my running *PC-MIX* on a 25-MHz 386 system. I had no problems when compiling a program or recalcing a spreadsheet in the background.

The idea of a simple but limited multitasker is an interesting one, and this current version is an attractive first step. But expect a few problems if you install this program. And if you don't have expanded memory, you should think twice before plunking down your money: limited to 640K, you'll be hard-pressed to run two full-size applications at once, much less three. PC

List Price: PC-MIX, Version 1.1, $49.95. **Requires:** 256K RAM (640K recommended), EEMS or EMS 4.0 memory recommended, DOS 2.0 or later. Not copy protected. Proware, P.O. Box 551314, Dallas, TX 75355; (800) 842-3787.

CIRCLE 444 ON READER SERVICE CARD

Don't drag your PC along! Take the shortcut between programs and files with Software Carousel®

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Here's how to make Software Carousel work for you.

Software Carousel is the amazingly easy way to switch almost instantly from WordPerfect to 1-2-3 to dBASE to DOS to whatever else you want. Or go from one file to another in the same program. All without saving or retrieving – or wasting a precious moment of your time. Or your computer's memory.

It works by creating a number of independent software slots to load your programs into. You get up to ten of these software slots, so you can load up to ten programs.

Need to crunch numbers? Hit a key and there's your spreadsheet. Need your word processor? Don't bother saving your spreadsheet file. Just whip over to your document and do your work. Snap back to your spreadsheet and it's just like you left it. It's like all your programs are "pop-ups," just a hotkey away.

Or load the same program into a few different slots, each with a different file. Now go from one to another in an instant.

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You may have heard about some other "environment" programs that claim to do something similar to Software Carousel. But there are several important differences.

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Other environment programs work with only some software. Software Carousel works with everything. Period. It even resolves conflicts among memory resident programs.

Other software creates a working environment that's complex, unfamiliar, with cramped little windows and strange commands. Software Carousel takes minutes to set-up just the way you want it. All your software looks and acts exactly as it always did.

It's so downright useful, even IBM® recommends it.

Even as you read this page, there are tens of thousands of Software Carousel users zipping through their work without laborious and repetitive commands. And without the usual 640K limit imposed by DOS. In fact, even IBM recommends Software Carousel for use with their most popular mainframe-to-PC communications package.

We think you'll agree, that with this kind of speed, convenience, and next-generation performance, $79.95 is a small price to pay.

Look for Software Carousel at software dealers everywhere. Or order direct from SoftLogic Solutions by calling us toll-free. If, after thirty days, you're not satisfied that Software Carousel is the right way to get that old PC technology off your back, we'll gladly arrange for a refund of your purchase price.

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–Ralph Evans, Attorney, Fullerton, CA

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–Colin Ralph, Ralph & Panzer, Inc., Seattle, WA

"Fantastic program. Great book. Saves me an hour a day! Thanks."
–Larry Pearsal, Rolling Hills Covenant Church, Rolling Hills Estates, CA

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#6

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"The CPU 386/20 performed flawlessly . . . a good choice at the right price." Nov 88 PC Magazine

PC WEEK "CPU 386/25. Its performance is top notch" Feb 89

CIRCLE 163 ON READER SERVICE CARD

NEW ON THE MARKET

by Lori Grunin

Serial I/O Controller For the Micro Channel

If much of the work you do with your Micro Channel machine involves serial communications, you may want to offload some of your CPU's burden onto the 16-MHz 80C186 processor located on **Metacomp**'s PScomm2/4 serial I/O controller board. The 16-bit bus-mastering board comes in two versions, the two-channel PScomm2 ($1,395) and the four-channel PScomm4 ($1,495).

The PScomm2/4's two-transmitter, two-receiver 85C30 Serial Communications Controllers (SCC) enable you to program each channel separately for protocols such as SNA, X.25, SDLC, and HDLC. The SCCs can be configured to operate in polled, interrupt, and DMA modes and set up for common interfaces, such as RS-232C. The board supports full-duplex DMA on all channels, and two of the channels can operate at full duplex at a rate of up to 2.48 megabits per second.

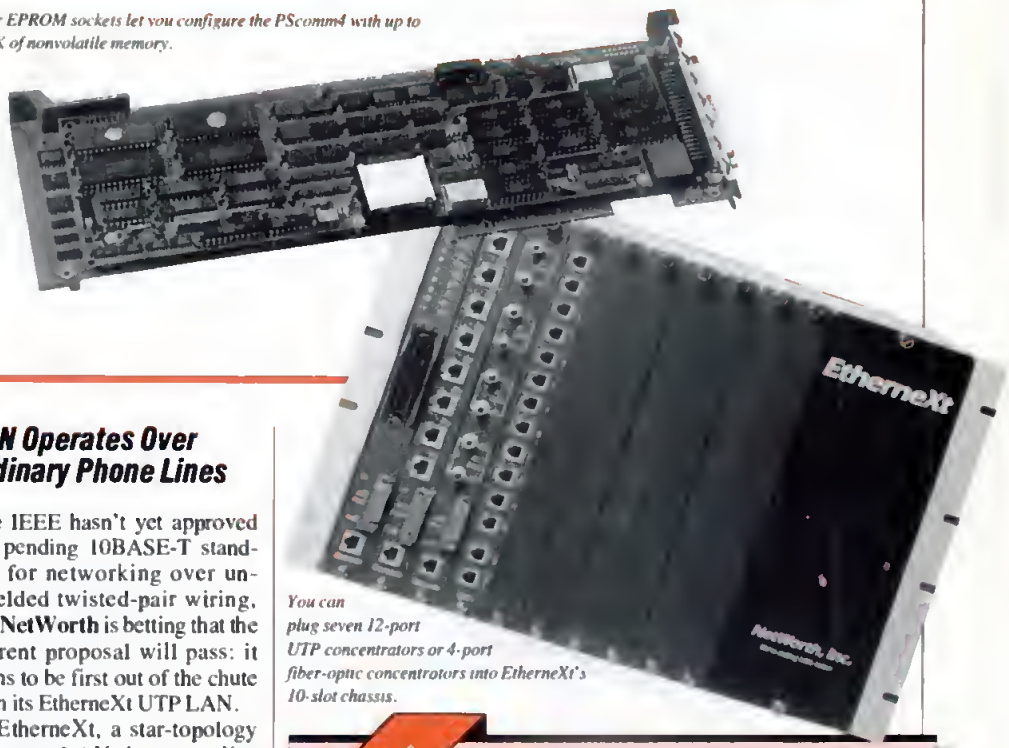
Four EPROM sockets, two of which are configurable with 256K of EEPROM or static RAM, will hold a maximum of 512K of nonvolatile memory. The PScomm2/4 comes with 512K of triported, byte-parity protected DRAM that serves the on-board 16-bit processor, local DMA communications controllers, and the Micro Channel. Eight LED indicators help you to monitor diagnostic and software status.

Metacomp offers optional communications software and firmware that include X.25, SNA, debug, and development tool kits and power-up diagnostics. You can currently obtain drivers for DOS 4.0.

List Price: PScomm2, $1,395; PScomm4, $1,495. **Requires:** Micro Channel machine. Metacomp Inc., 15175 Innovation Dr., Suite A, San Diego, CA 92128; (619) 673-0800.

CIRCLE **439** ON READER SERVICE CARD

Four EPROM sockets let you configure the PScomm4 with up to 512K of nonvolatile memory.



You can plug seven 12-port UTP concentrators or 4-port fiber-optic concentrators into EtherneXt's 10-slot chassis.

LAN Operates Over Ordinary Phone Lines

The IEEE hasn't yet approved the pending 10BASE-T standard for networking over unshielded twisted-pair wiring, but **NetWorth** is betting that the current proposal will pass: it plans to be first out of the chute with its EtherneXt UTP LAN.

EtherneXt, a star-topology Ethernet LAN that complies with the existing IEEE 802.3 standard, consists of 8-bit ($495) and 16-bit ($595) network cards and a 12-port UPT concentrator ($1,995) that can be configured in various ways. The board comes in an MCA version, too.

The system supports 1,024 nodes per network, with up to 10,000 workstations. Stations can be up to 328 feet from a concentrator, and fiber-optic cabling will allow concentrators to stand over 328 feet apart. Data transfers occur at a rate of 10 megabits per second.

EtherneXt incorporates CSMA/CE—Carrier Sense Multi-Access with Collision Elimination—the firm's proprietary scheduling scheme for avoiding signal collisions.

List Price: EtherneXt, 8-bit network card, $495; 16-bit network card, $595; 10-slot chassis with power supply, $1,220; 12-port UTP concentrator, $1,995. NetWorth Inc., 8101 Ridgepoint Dr., #107, Irving, TX 75063; (800) 544-5255, (214) 869-1331 (in Tex.).

CIRCLE **440** ON READER SERVICE CARD

HOT PROSPECT

$295 CAT Reader Unites OCR and Hand Scanners

Computer Aided Technology's $295 *CAT Reader* promises to give your 200-dot-per-inch hand scanner the OCR capabilities previously available only in desktop scanners.

When using a hand scanner, text tends to skew—characters compress and lines slant—making character recognition difficult. *CAT Reader* can handle a skew of up to plus or minus 10 degrees. The program merges the pieces scanned by a hand scanner into one page, can exclude graphics, and can perform OCR solely on selected sections of pages.

Using a feature-extraction algorithm, *CAT Reader* reads monospaced, proportionally spaced, and typeset characters, including those using kerning and ligatures. Recognition occurs at an average of 75 characters per second on an IBM PC AT or compatible with an accuracy of approximately 99.5 percent, according to Computer Aided Technology.

The software comes with ten pretrained typestyles, but you can train it (interactively or noninteractively) to recognize other characters between 6 and 20 points. Editing *CAT Reader*'s font dictionaries permits correction of mistrained characters.

CAT Reader supports The Complete Hand Scanners, The Complete Half Page Scanner, DFI Handy Scanners, GeniScan GS-2000, Logitech ScanMan, Mitsubishi Hand Scanner, NISCAN, and SkySCAN, and outputs files in *WordPerfect*, *WordStar*, and ASCII formats.

List Price: *CAT Reader*, $295. **Requires:** Hand Scanner, 640K RAM, graphics adapter, DOS 3.*x*. Not copy protected. Computer Aided Technology Inc., 7411 Hines Pl., #212, Dallas, TX 75235; (214) 631-6688.

CIRCLE **436** ON READER SERVICE CARD

NEW ON THE MARKET

Xerox Graph Ports Scientific, Technical Graphing from Macintosh to Windows

Adding to the growing list of software ported from the Macintosh, **Xerox** brings the acclaimed technical graphing package *Cricket Graph* to the PC under the name *Xerox Graph*. The $295 program, which includes the rarely found capability to create polar plots, runs under *Microsoft Windows*.

Xerox Graph produces variations on pie, column, bar, line, area, scatter, double-y line and scatter graphs, as well as horizontal and vertical error bars and text charts. It also performs simple, polynomial, logarithmic, exponential, and interpolated curve fitting.

Tiling windows allows a user to work on multiple graphs simultaneously, and graphs can be resized and repositioned by dragging with the mouse. You can also overlay certain types of graphs and print several graphs on the same page.

The worksheet built into *Xerox Graph* handles a data matrix of up to 40 columns by 2,700 rows (also the maximum data-set size); it enables you to sort, recode, and transform data as well as perform simple math, calculate frequencies, and smooth data.

Text may be positioned anywhere on the page, and you control font, size, typestyle, text and background colors, orientation, and justification. The package comes with two Bitstream typestyles.

Xerox Graph imports files in .WK?, XYLK, .DIF, ASCII, and Macintosh Cricket Graph 1.2 formats and will export graphs as a *Windows* Metafile for use with *Ventura Publisher* and *Xerox Presents*.

List Price: *Xerox Graph* (includes a runtime version of *Microsoft Windows*), $295. **Requires:** 640K RAM (1MB recommended), graphics adapter (mouse recommended), DOS 3.1 or later. Not copy protected. Xerox Desktop Software Business Unit, 9745 Business Park Ave., San Diego, CA 92131; (800) 822-8221.

CIRCLE **437** ON READER SERVICE CARD

Sysgen's Removable Disk System Eases Storage Crunch

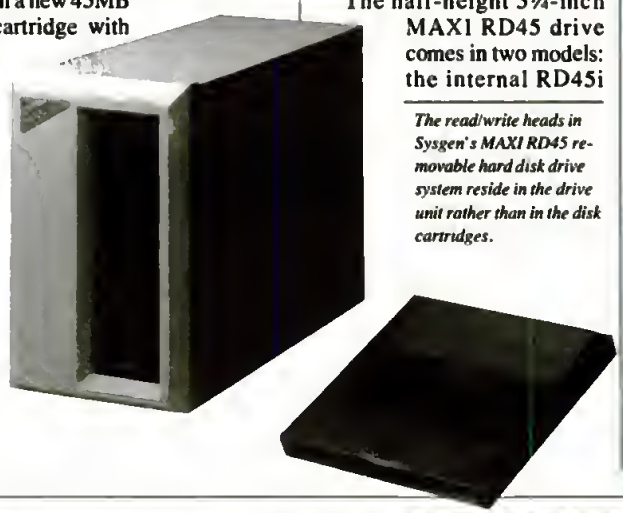
Expanding your system's storage becomes as easy as slipping in a new 45MB cartridge with Sysgen's MAXI RD45 removable hard drive subsystems. The SCSI drive unit features 25-millisecond disk access times, 1:1 interleave, and a data transfer rate of up to 500K per second.

The half-height 5¼-inch MAXI RD45 drive comes in two models: the internal RD45i ($1,325) and the external RD45e ($1,625). Two SCSI interface kits, one for the PC bus ($195) and one for the MCA bus ($250) make possible the RD45's 16-bit DMA transfers.

Sysgen's $175 cartridges hold 44.44MB of data, have a write-protect switch, and are rated at 20,000 hours MTBF.

List Price: MAXI RD45i, $1,325; MAXI RD45e, $1,625; MAXI PCD kit (PC bus interface), $195; MAXI MCD kit (MCA interface), $250; 45MB cartridge, $175. Sysgen Inc., 556 Gibralter Dr., Milpitas, CA 95035; (408) 263-4411.

CIRCLE **441** ON READER SERVICE CARD



The read/write heads in Sysgen's MAXI RD45 removable hard disk drive system reside in the drive unit rather than in the disk cartridges.

2,400-bps Modem Won't Monopolize Your Serial Port

If you've been sacrificing the I/O ports on your machine grudgingly, **Micro Electronic Technologies'** $295 pass-thru modem will let you put your irritation aside for at least one peripheral.

The company's Hayes-compatible 2400X provides 2,400-bit-per-second communications when active and feeds data to another device when off.

The external modem is 5.5 by 4.2 by 1.5 inches; made possible by the use of surface-mount technology, automatic fallback to 300 or 1,200 bps, and the ability to store phone numbers in nonvolatile memory. One DB-25, one 9-pin, and two RJ-11 jacks comprise connection options.

List Price: MET 2400X, $295. **Requires:** RS-232 port. Micro Electronic Technologies Inc., 35 South St., Hopkinton, MA 01748; (508) 435-6481.

CIRCLE **442** ON READER SERVICE CARD

LED indicators and a modem/serial switch adorn the front panel of the small-footprint MET 2400X modem.

12-MHz Compaq Deskpro 286e Offers Small Footprint, VGA on Motherboard

If you had doubts about the vitality of the AT-compatible market, **Compaq's** new 12-MHz Deskpro 286e should lay them to rest.

The machine comes in three models, all with 1MB of RAM on the motherboard and a high-density 5¼-inch floppy disk drive. The $2,699 Model 1 has no hard disk drive, while the $3,199 Model 20 and $3,599 Model 40 have 20MB and 40MB hard disk drives, respectively.

Since Compaq integrates the VGA, serial and parallel ports and the drive controller into the motherboard, you don't lose any of the four 16-bit expansion slots to one of these cards.

List Price: Compaq Deskpro 286e, Model 1, $2,699; Model 20, $3,199; Model 40, $3,599. Compaq Computer Corp., 20555 FM 149, P.O. Box 692000, Houston, TX 77269; (713) 370-0670.

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$80 QuickTalk: Janitor for Dialed-in Data

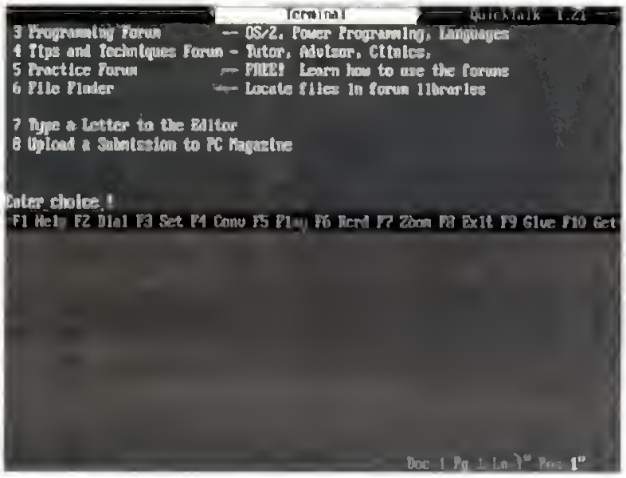
PC HANDS ON

BY BRUCE BROWN

Don't you just love reaching out and downloading data via modem? Don't you just hate cleaning it up for your application? With *QuickTalk*, you won't have to play janitor anymore.

SilverSoft's $79.95 RAM-resident telecommunications program takes away the mess, saving you time and aggravation. It lets you bring on-line database dumps, transferred files, e-mail, or whatever else you get via modem into your application program directly.

QuickTalk won't make you save the incoming information as an ASCII text file and then clean it up by getting rid of unwanted carriage returns. Your application will treat data coming in from *QuickTalk* just as it would if someone were typing it in on your keyboard.



With QuickTalk *loaded, you can import data from PC MagNet, for example, directly into a* WordPerfect *5.0 file without having to clean it up.*

QuickTalk takes up just 76K of RAM. Whenever you want, just pop up *QuickTalk*, dial the computer or service of your choice, and hit F10 to transform *QuickTalk* into your personal data-entry drone—all without leaving your original program.

QuickTalk is convenient for retrieving ASCII files from anywhere, not just from the telephone, and bringing them into any other program, whether it's a spreadsheet, database manager, or whatever. You can also use *QuickTalk* to download and upload files in the background while you work with other software.

If you live by electronic mail or download lots of files, *QuickTalk* may be just what you need to make life via modem a little less tedious.

List Price: *QuickTalk*, Version 1.21, $79.95. **Requires:** 76K free RAM, modem and telephone line, DOS 2.0 or later. Not copy protected. SilverSoft Inc., 130t Geranium St. NW, Washington, D.C. 20012; (202) 291-8212.

CIRCLE **433** ON READER SERVICE CARD

OS/2 Programming the Duncan Way

PC BOOK REVIEW

BY ROBERT L. HUMMEL

Writing programs for OS/2 used to be costly in terms of both time and money. But now, for a very modest outlay, you can acquire a suitable assembler or compiler and a copy of OS/2. Combine these with Ray Duncan's latest book, *Advanced OS/2 Programming*, and you can be writing OS/2 programs tonight.

Advanced OS/2 Programming contains everything you need to know to write character-based applications with the 250-plus OS/2 kernel functions. You won't find, however, discussions of object-oriented programming or the specifics of the Presentation Manager. Dedicated to teaching OS/2 programming rather than OS/2-speak, the author shuns the cryptic naming conventions, complex macros, and bloated header files usually associated with OS/2. Readers get straight talk and plenty of examples.

After reviewing the basics, Duncan plunges into advanced OS/2 techniques. This section explains memory management, multitasking, interprocess communication, and techniques for direct hardware access. A final section covers special-purpose programs, including filters, device drivers, device monitors, and dynamic-link libraries (DLLs). The 270-page reference section provides complete specifications of all OS/2 kernel functions, indexed alphabetically and topically.

Straightforward explanations, useful programming examples, and comprehensive reference sections combine to make *Advanced OS/2 Programming* an indispensable resource for all OS/2 programmers. A companion disk that contains the source code for functions and programs is available from Microsoft Press for $19.95.

List Price: *Advanced OS/2 Programming*, by Ray Duncan, $24.95; companion disk, $19.95. **ISBN:** 1-55615-045-8. Microsoft Press, 16011 NE 36th Way, Box 97017, Redmond, WA 98073; (206) 882-8080.

CIRCLE **434** ON READER SERVICE CARD

@Stat: Lotus 1-2-3 Math Manipulations

PC HANDS ON

BY BARRY SIMON

@Stat is a $295 *Lotus 1-2-3/Symphony* add-on, published by the British firm 4-5-6 World and distributed in this country by Intex Solutions. As the name implies, it gives you additional @functions inside *1-2-3* that allow statistical and mathematical manipulations. Once installed through Lotus's add-on manager, *@Stat* acts exactly like the built-in Lotus @functions.

@Stat's 44 functions are divided into three sets: four general mathematical, including a Simpson's rule numerical integration; 15 that analyze those numbers in a spreadsheet range that are also within a certain numerical range; and 25 statistical functions.

The core of statistical routines includes linear correlations, student's T-test, and percentiles. For many of these, two different versions of the function are included: one that analyzes a single range of numbers and a second that analyzes a pair of ranges that represent the values sampled together with their frequencies.

Keep in mind that spreadsheets with *@Stat* functions will not be usable by *1-2-3* users who don't have *@Stat*.

For some, this product is overpriced—it would take me only a few days to duplicate the numerical analysis parts of *@Stat* in Turbo Pascal—but if you need statistical analysis and use *1-2-3*, it may be worth buying, despite the high price.

List Price: *@Stat*, Version 1.0, $295. **Requires:** 36K free RAM; *Lotus 1-2-3*, Version 2.0 or 2.t, or *Symphony*; DOS 2.0 or higher. Not copy protected. Intex Solutions, 161 Highland Ave., Needham, MA 02194; (617) 449-6222.

CIRCLE **435** ON READER SERVICE CARD

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Multi-table form dynamically displaying information from three related tables.

You don't have to be a programmer to have easy access to our highly sophisticated, powerful relational database, Paradox® 3.0.

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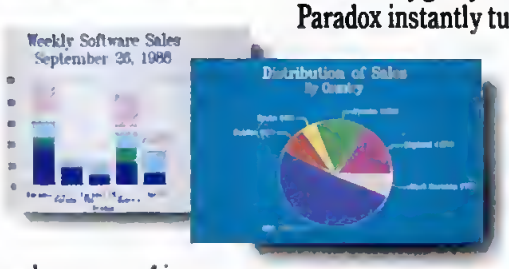

With Paradox 3.0, there are no Unclears, no Unknowns. You don't need an army of in-house technical support people. And best of all, you *don't have to be a programmer* to be a pro with Paradox. It's all gain, no pain.

"Query-by-Example" for example

Use this checkmark and you're using QBE.

It's that easy. Let's say you need to know in a hurry which of your Los Angeles customers bought more than 5 pairs of white shoes. First ✓ the customer field, then type "LA," "white," and ">5," and you're done. Paradox gives you the right answer right now. And how much programming to do all that ? Zero.

If your database experience so far is limited to the flat-file type rather than relational, or even if a spreadsheet is the only program you've used before, Paradox gets you up and running immediately with just a ✓.

Record-locking and Auto-Refresh make the network safely network

Paradox has become the leading networker because it handles multi-users intelligently. If someone in your group or network has accessed a record, automatic record-locking keeps everyone else from changing it.

That way, two or more people can't change the same data at the same time. (As a bonus, Paradox also tells you *who* is using a record at a particular instant.)

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Paradox, for the looks of things

Presentation-quality graphics are another Paradox distinction. They give you and your work the professional look.

Paradox instantly turns your tables into graphs with *one* keystroke—and in multiuser environments, with a few keystrokes your graph can show up-to-the-minute changes. Not only does everyone get the picture, they get an accurate picture.

Award-winning Paradox Family

Paradox 3.0 is the latest addition to the award-winning Paradox Family. **Paradox OS/2 and 386 received PC Magazine's BEST OF 1988 AWARD in the database category.**

it out

To order a trial version of Paradox 3.0 ($14.95) or a demonstration disk ($4.95), call (800) 345-2888, extension 100. Paradox owners may upgrade ($175.00) by calling (800) 331-0877. (Please have your serial number available.)

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BORLAND

Code: MP29

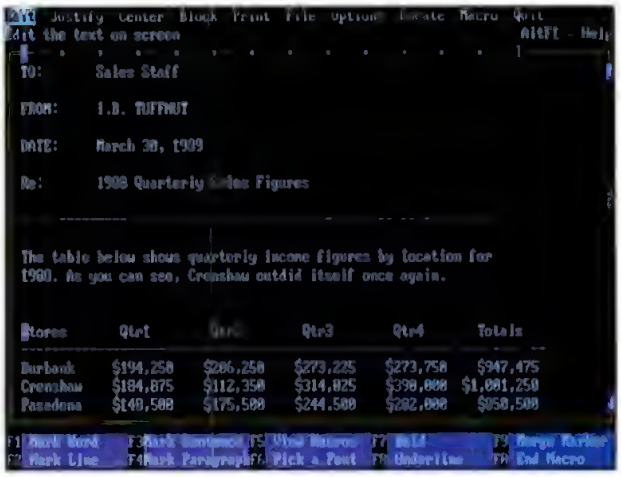
The Heavy-Duty Word Processor for 1-2-3: All the Comforts of 1-2-3, Including 1-2-3

PC HANDS ON

BY CRAIG STINSON

The Heavy-Duty Word Processor for 1-2-3 sounds like a pretentious title for something that comes on two diskettes in a no-frills plastic box. But surprise! This $45 item is a gem—for a certain class of user.

Not an add-in but a *pass-through*, *HDWP* is a word processor designed specifically for those who spend their whole day inside a spreadsheet. You invoke it by typing HD 1-2-3 at the DOS command line. DOS loads *HDWP*, and *HDWP* immediately invokes *Lotus 1-2-3* as a child process. From the spreadsheet, you can skip back to the word processor by tapping twice on the numeric keypad's 5 key. Quitting the word processor takes you back to the spreadsheet but leaves *HDWP*—and your current text—memory-resident; quitting the spreadsheet returns you to DOS and removes *HDWP* from memory.



Commands are similar to those of 1-2-3, evoked with function keys or slash combinations. The rectangular border, shown above, can be changed to a spreadsheet border.

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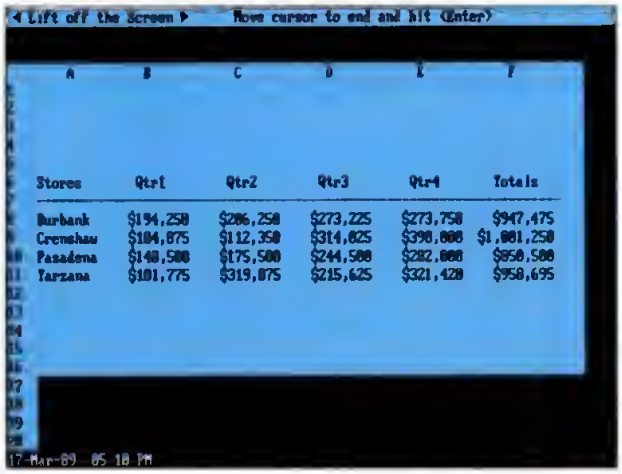


The Heavy-Duty Word Processor *runs* Lotus 1-2-3 *as a child and lets you toggle between the programs. It also lets you cut and paste between* 1-2-3 *files.*

The role reversal makes sense. Having *HDWP* play the parent, not the child, means you can also run it standalone. Or run it with any other application that doesn't overwhelm your memory resources (*HDWP* by itself eats about 128K, so you'll need a full 640K to use it effectively).

Lotus dwellers will feel right at home in *HDWP*. The horizontal menu at the top of the screen, the flashing status indicator in the upper-right corner, and even the retention of Lotus-style print commands (/Print Range, /Print Go, /Print Line) conspire to present the lowest-possible learning hurdle. You can even throw out the default rectangular window frame in favor of spreadsheet borders if you wish.

HDWP offers a respectable array of editing features, including a simple search/replace (without wildcards or other fancy options), the customary block operations (copy, move, delete), an undo command, and the ability to define a custom menu of six print attributes. There is also a mail-merge capability (tailored to work with *1-2-3* databases), a built-in macro recorder, and a stand-alone spelling checker. Although the mail-merge facility works with spreadsheet databases, it also accepts data from any quote- and comma-delimited text file.

The performance of *HDWP* is satisfactory, if not spectacular; the program's biggest drawback in terms of speed is its insistence on updating the screen, line by line, as it carries out a search/replace or other global operation.

From the perspective of its intended user, probably the most significant virtue of *HDWP* is its ability to exchange data with spreadsheet programs. A /File Transfer command lets you import full or partial .WK? files into *HDWP*. The imported data can be from *1-2-3* (any version), *Symphony*, or even *Quattro*. More important, the worksheet in question does not have to be in memory; that means that *HDWP* can import very large models as easily as small ones.

Going the other direction, a /File Xtract command writes out selected text from *HDWP* as a .WKS file. This file, in turn, can be folded into any flavor of *1-2-3* worksheet via /File Combine.

And just in case these transfer facilities aren't enough, *HDWP* sports a *DESQview*-like screen-capture utility that lets you mark any portion of a screen (text mode only) and port it into the word processor. This feature makes it easy to transfer your row and column headings along with your labels and numbers.

You can make the linkage between an *HDWP* file and spreadsheet data permanent and "hot" by means of a merge command. Just insert a merge marker as well as the specs for a spreadsheet file and range, and *HDWP* gets the current values from that range every time you print. A similar procedure allows you to hot-link to a Lotus graph.

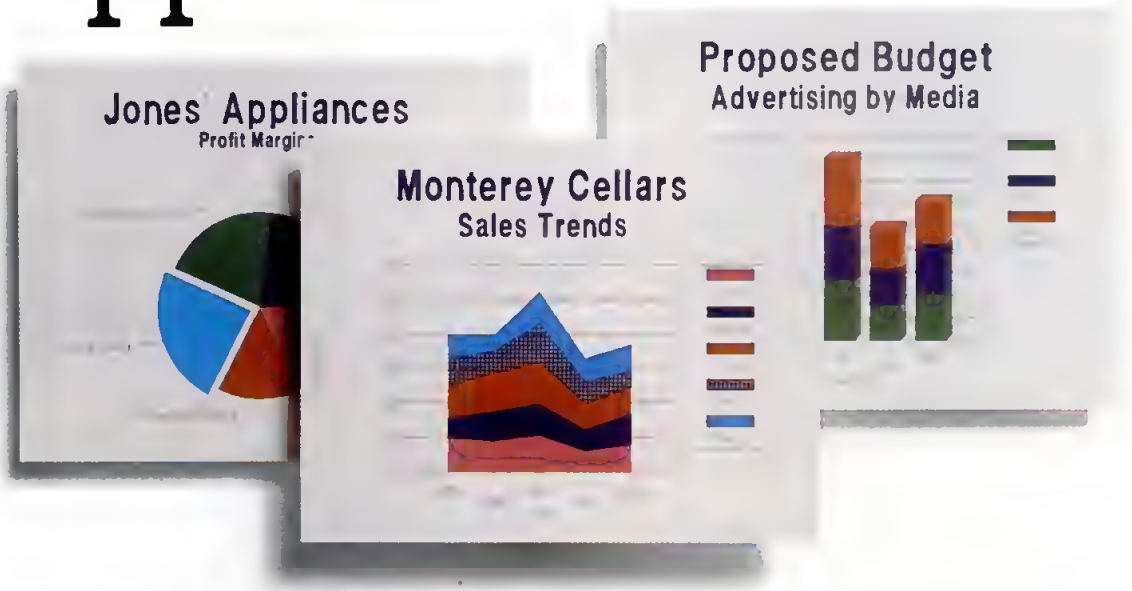
HDWP is not going to intimidate WordPerfect Corp. It doesn't do columns, its tabs are fixed-width, it doesn't have a thesaurus, and it doesn't have style sheets. It's just a hassle-free, single-minded product that offers unusual value for the money. PC

PC MAGAZINE FACT FILE

***The Heavy-Duty Word Processor for 1-2-3*, Version 2.0**
Bi-Intelligence Inc.
210 E. 86th St., #501
New York, NY 10028
(212) 439-6900
(800) 451-0303 (orders only)
List Price: $45
Requires: 640K RAM (to run resident with *Lotus 1-2-3*), DOS 2.0 or later.
In Short: A well-designed, modestly priced word processor with features tailored for spreadsheet users. Not copy protected.

CIRCLE 431 ON READER SERVICE CARD

Appearances count.



Quattro: The Professional Spreadsheet

Good ideas usually vanish in bad presentations. Important data is missed because it can't be shown. Quattro®, meanwhile, lets you make colorful, graphic improvements in the way you make your spreadsheet presentations.

Quattro does the impossible.

Quattro's advanced graphics include graphs that *can't be done* by the leading spreadsheet. Quattro also includes more graph types than the best-known spreadsheet—like horizontal bar, line-bar, 3-D bar, and area charts.

Quattro's spreadsheet graphics are also completely and easily customizable. With Quattro's color at your fingertips, you can easily highlight, compare, analyze, print, present, discuss and decide.

Quattro is 100% compatible with the Other Spreadsheet.

Quattro is file, macro, and keystroke compatible with Lotus® 1-2-3®. Quattro can read and write 1-2-3 and Symphony® files, so none of your existing files are lost when you make the graphic switch to Quattro.

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Because Quattro is so compatible with the Other Spreadsheet, you can switch to Quattro without having to learn a new program.

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Quattro's presentation-quality graphics are part of the spreadsheet program, not a separate program—which you incidentally pay separate money for. You print out your graphics from *inside your spreadsheet*, instead of being sent off to a separate print program.

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the LAN ALTERNATIVE!

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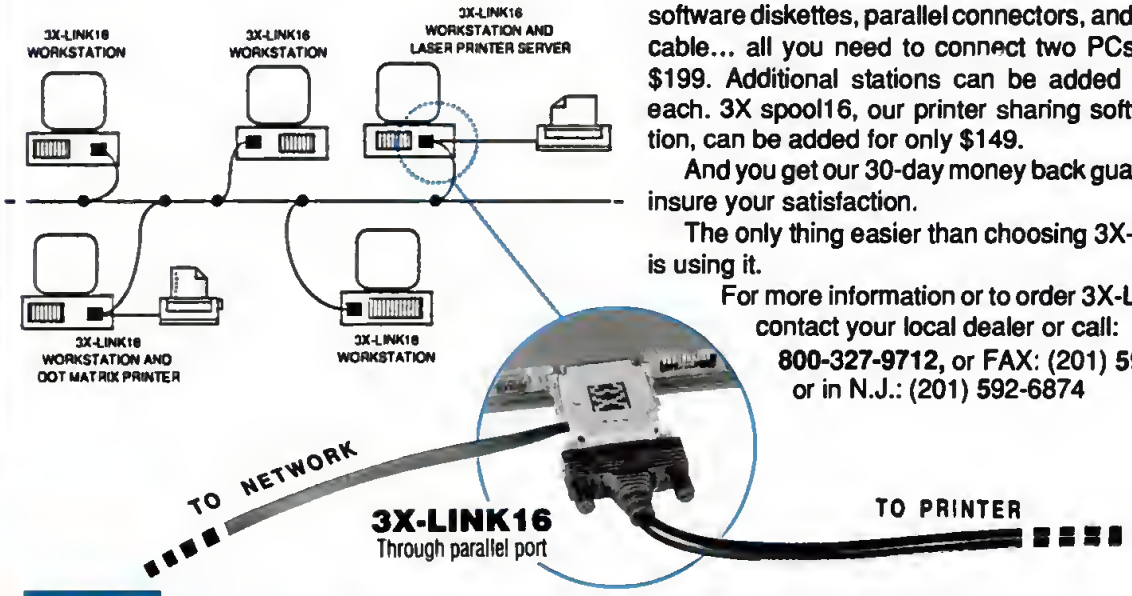

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And our optional 3X-Spool16 intelligent printer spooling software lets you share connected printers (up to 16), automatically managing paper sizes all without waiting. And without buying limited, expensive printer sharing boxes.

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3X-LINK16 comes complete with 3 1/2" and 5 1/4" software diskettes, parallel connectors, and a 12 foot cable... all you need to connect two PCs for only $199. Additional stations can be added for $139 each. 3X spool16, our printer sharing software option, can be added for only $149.

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3X USA Corp. One Executive Drive Fort Lee N.J. 07024
Phone: (800) 327-9712

CIRCLE 234 ON READER SERVICE CARD

PC UPDATE

by Elisa J. Hirsch

Lotus Plans Another Upgrade Path For 1-2-3

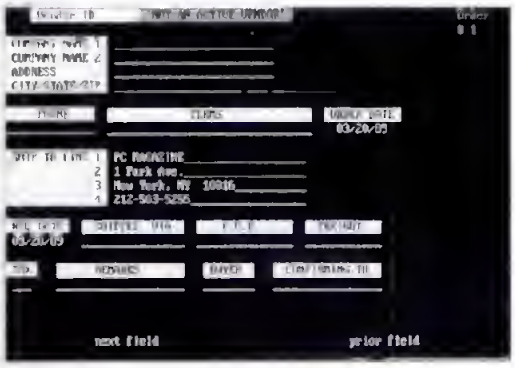
Soon after *Lotus 1-2-3*, Release 3, ships later this year, Lotus Development Corp. will begin selling ***Lotus 1-2-3*, Release 2.2,** an upgrade for owners of PCs not equipped with the extra memory and faster processors that Release 3 will demand. Release 2.2 will provide spreadsheet linking, undo, print style sheets, and a macro library manager. Macro learning, which is now available as an add-in for Release 2.01, will be incorporated into the main menu. Release 3, which will run under both DOS and OS/2, will incorporate all of these features, plus it will let users create layered or 3-D spreadsheets. Lotus expects to ship Release 3 in June and Release 2.2 several months later. Pricing has not been established. Lotus Development Corp., Cambridge, Mass.; (617) 577-8500.

Draw Applause Drives Film Recorders

Ashton-Tate Corp. announced the availability of new device drivers for its ***Draw Applause*** presentation graphics software. The new drivers support film recorders, laser printers, and electronic presentation systems including the Apple LaserWriter II PostScript printer, the General Parametrics VideoShow (Executive, Professional, and SlideMaker Image Recorders), and the Hewlett-Packard PaintJet color inkjet printer. The new device drivers are free for registered users of *Draw Applause* and are contained on one diskette. Ashton-Tate Corp.; Torrance, Calif.; (213) 329-8000.

MiccaSoft Adds an Accounts Payable Module

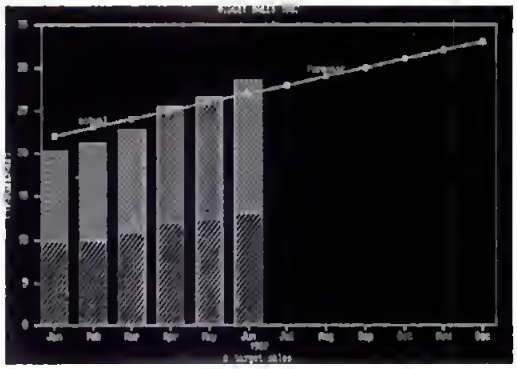
The **Small Business Accounting** series from MiccaSoft now includes an Accounts Payable module. The upgrade allows users to print checks and various reports including discounts taken/lost, pending orders, and monthly vendor purchases. The cost of the new module is $125; however, registered owners of existing modules are entitled to a 50 percent discount (plus $7.50 for shipping and handling). MiccaSoft Inc., New Braunfels, Tex.; (512) 629-4341.



An Accounts Payable input screen in the Small Business Accounting series.

Enhanced 2-D Graphics for Lotus 1-2-3

The *Lotus 1-2-3* and *Symphony* graphics add-in, ***2-D Graphics*,** has been enhanced to mix line graphs and Hi-Lo-Open-Close charts with-



The enhanced 2-D Graphics package enables you to mix line graphs and bar charts in one graph.

in one graph. In addition, *2-D Graphics* now sports improved log-scale display, manual scaling of bar graphs, and expanded titles and legends. Version 1.01 of *2-D Graphics* retails for $145 (plus $5 shipping and handling). Upgrades are available from Intex for $25 (plus $5 shipping and handling). Intex Solutions Inc., Needham, Mass.; (617) 449-6222.

Generic Software Repackages Its CADD Software

Generic Software has added several modules to its *CADD* packages. ***Generic CADD Level 3*** (which has EMS support, hatches, and dynamic drag) now includes Generic's DotPlot, which allows *CADD* drawings to paint on dot matrix and laser printers, and DeskConvert, which converts *CADD* drawings into formats compatible with desktop and paint programs. In addition, *Level 3* includes pen plotter support. *Level 3* will sell for $299.95. *Generic CADD Level 2*, which has auto-dimensioning and snaps to trims, will be enhanced with DeskConvert and PenPlot. *Level 2* already contains DotPlot and will retail for $149.95. Generic's *CADD Starter Kit* now includes the updated *Generic CADD Level 2*, a CADD tutorial workbook, Generic's Basic Home Design Symbols Library, and several sample drawings. It retails for $199.95. Generic Software Inc., Bothell, Wash.; (206) 487-CADD.

Freedom of Press Adds Color Drivers

***Freedom of Press*,** Release 2.0, adds drivers for six color printers. In addition, Release 2.0 interprets files faster than previous versions. The color drivers provided by the new version support the Hewlett-Packard PaintJet, Howtek Pixelmaster, Xerox 4020 ink jet printers, and assorted 24-wire dot matrix printers from AMT, Fujitsu, and NEC. Upgrades are $45 for all registered users, and new packages retail for $495. Custom Applications Inc., Billerica, Mass.; (508) 667-8585.

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Compaq III 20 mb/40mb	3595/4150
Compaq 386-S model 1/20/40	2925/3465/3695
Compaq 386-25 110/300	7195/9395
Compaq SLT w/20 meg	4395
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Model 30 w/1 floppy & 20 mg	1725
Model 50 - 30/60	2750/3195
Model 60 - 40/70	3295/3650
Model 70 - 60	4325
Model 80 - 40/70	4270/4875
Model 80 - 11S	6195

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80387-20	409
80387-16	360
80287-8	199
80287-10	225
8087-3/8087-2	99/129
256K Chips/64K Chips	Call

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NEC

NEC Multisync II A	$519
NEC Multisync II	589
NEC Multisync Plus	879
NEC Multisync XL 19"	2199

IBM

Mono 8503	$209
Color Display 8512	459
Color Display 8513	559

PRINCETON

MAX12	$149
Ultra 16	879
HX12E	449
Ultrasync	509

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RGB80 8762	259
EGA 9CM0S3	369

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1 floppy, 512K, AT style keyboard, monographics card, mono monitor — $799
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1 mb Ram, 1 2 floppy — $995
Bulldog 386 16 mhz, 1 mb Ram, 1 2 floppy — $1695

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AST Premium 286 Model 80, 10 mhz, 0 wait state, S12K, DOS keyboard, 1.2 floppy — $1395
AST Premium 386 Model 300 20 mhz, 1 2 floppy, 1 mg, DOS, keyboard — $2675
All AST computers carry a 1 year warranty

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NEC Multispeed EL	$1549
NEC Multispeed HD	2299
Toshiba 1000	825
Toshiba 1200	2299
Toshiba 1200F	1395
Toshiba 3100E	2889
T3200/T5100	3745/4795
Zenith Super Sport 20 mb	2325
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DRIVES

Seagate 20 dmb w/contr ST225	$259
Seagate 30 mjb w/contr ST238	279
Seagate 40 mb for AT ST251-1	409
Seagate 40 mb for AT ST251	349
Seagate 80 mb ST4096	575
CMS 5¼" ext. 360K for PS/2	179
CMS 5¼" ext. 1.2 mb for PS2	199
Pacific Rim 5¼" ext. 360K for PS/2	179
Pacific Rim 5¼" ext. 1 2 for PS2	199
Toshiba 3½" 720K int	89
Toshiba 3½" 1 44 mb int	105
Toshiba 5¼" 360K int	68
Toshiba 5¼" 1 2 mb int	99
Bernouli Box II 5¼" 20 mb int	955
20 mb ext. w/card	1195
dual 20 mb ext. w/card	1769
Plus Hard Card 40	649
Plus Hard Card 20	525
Priam 60 mb AT	629
Priam 43 mb AT	449

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Microsoft Mouse w/PC paint brush	99
Mousesystems Mouse	89
Logitech Mouse C7 Plus/Hi Res	69/89
Logitech Scan Man	199

PRINTERS

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LX 850 264 CPS, 54 NLQ	339
FX 1050 264 CPS, 54 NLQ	429
LQ 500 180 CPS, 60 NLQ	279
LQ 850 330 CPS, 88 NLQ	519
LQ 950	579
LQ 1050 330 CPS, 88 NLQ	719
LQ 25S0 400 CPS, 108 NLQ	899

OKIDATA

182 Plus 180 CPS, 30 NLQ	229
320/321 300 CPS, 62 NLQ	339/465
390 24 pin 270 CPS, 90 NLQ	465
391 24 pin 270 CPS, 90 NLQ	639
292 240 CPS, 100 NLQ	439
293 Plus 240 CPS, 100 NLQ	575
393 450 CPS, 120 NLQ	995

TOSHIBA

321 SL 216 CPS, 72 NLQ	479
351 SX 350 CPS, 100 NLQ	950
341 SL 216 CPS, 72 NLQ	629
311 Express	389

NEC

2200	359
5200	519
5300	669

PANASONIC

1124	339
1180/1191	195/259
1091/1092 Model II	189/329
1524	549
1S92/1595	369/399
3131/3151	315/359

HEWLETT-PACKARD

Laser Series II	1695
Desk Jet	749
Pacific Data 1 mg/2 mg	285/489
Pacific Data 25-N-1	269

IBM

Proprinter X24	615
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6 foot parallel cable — $19

GRAPHICS CARDS

Everex Micro Enhancer	$149
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Hercules In Color	219
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Orchid Pro Designer + w/512K	399
Paradise Auto Switch 480	199
Paradise VGA Plus	265
Paradise VGA Professional	479
STB Chauffeur HT	135
STB Multi Res II	169
Vega Deluxe	189
Vega VGA	265
Vega Fastwrite	339
Vega V Ram	439
ATI Wonder EGA/VGA	229/439

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Chartmaster	205
Clipper	419
D Base IV	469
DBXL	125
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Foxbase +	189
Freelance Plus	329
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Harvard Graphics	275
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Microsoft Excel	239
Multimate Advantage II	269
Peachtree Ii Complete	149
PFS Prof Write	119
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Paradox 3 0	449
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Revelation	469
Super Calc IV 1.0	285
Symphony 1.2	419
Ventura Desktop Publ	449
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Wordstar 2000 + 3.0	239
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Everex 60 m b	$550
Archives 40 mb int	299
CMS 150 mb internal	729
external	779
Maynstream 60 PS/2 w/card for model 50, 60 & 80	869

MULTI FUNCT. BOARDS

AST Advantage w/128K	$229
AST Advantage Premium w/512K	395
AST 6 Pack Plus w/384K	229
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AST Rampage 286	385
AST Rampage 286-2 for Model 50/60	549
AST Hotshot	355
Everex Mini Magic w/o K	59
Intel Above Board + w/512K	379
Intel Above Board PS + w/512K	429
Intel Inboard 386 w/adapter	895
Intel Inboard 386 for PC w/1 mb	559
Intel Above Board II Plus for PS/2 w/o K	279
Irma Board II	685
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Orchid Ramquest Extra w/o K	279
Orchid Ramquest XT/AT w/o K	239
Orchid Tiny Turbo 286	259
Orchid Ramquest II Z w/o K	169
Orchid Twin Turbo	349

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Everex 1200 int/ext	$79/115
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Hayes 1200/2400	279/419
Migent Pocket Modem	89
Practical Peripherals half card 2400 w/Procomm	159
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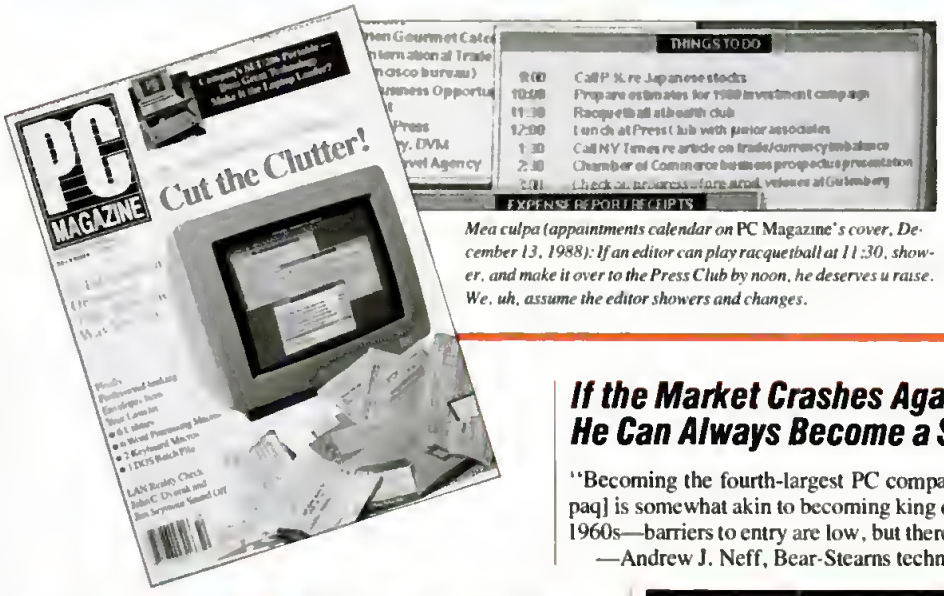
CIRCLE 481 ON READER SERVICE CARD

COMMUNIQUÉS

by Bill Howard



Mea culpa (appointments calendar on PC Magazine*'s cover, December 13, 1988): If an editor can play racquetball at 11:30, shower, and make it over to the Press Club by noon, he deserves a raise. We, uh, assume the editor showers and changes.*

Bug Report

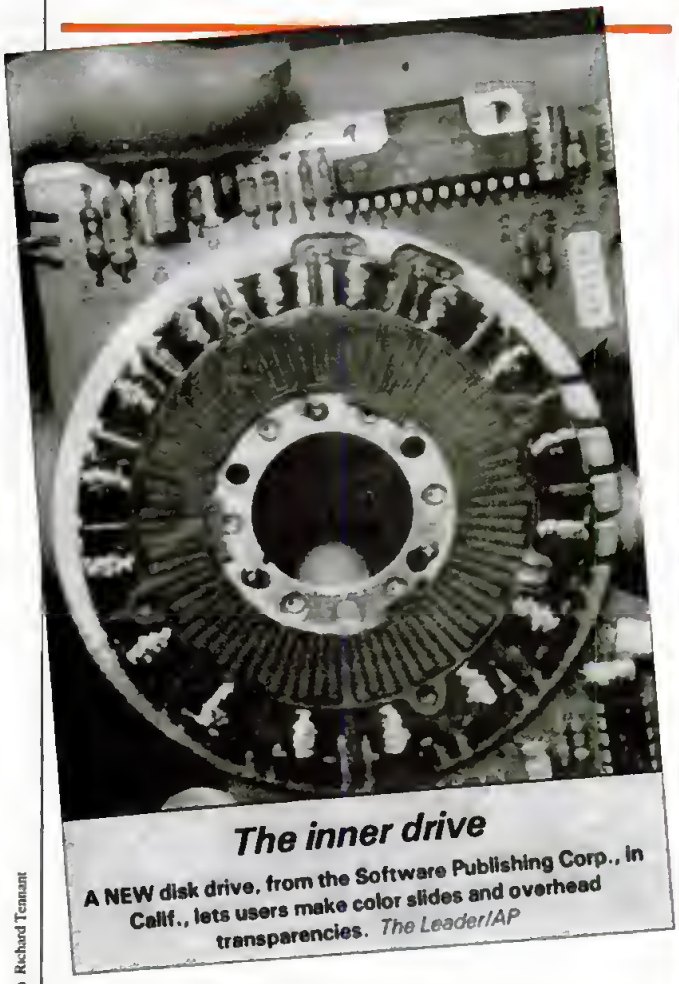
"In bringing the product to market, Ashton-Tate has acknowledged that some bugs and incompatibility problems remain, especially in the special portion that deals with specific query language, or SQL . . ."

—The New York Times, *January 22, 1989*

If the Market Crashes Again, He Can Always Become a Stand-up Comic

"Becoming the fourth-largest PC company [after IBM, Apple, and Compaq] is somewhat akin to becoming king of a Central African country in the 1960s—barriers to entry are low, but there is very little job security."

—Andrew J. Neff, Bear-Stearns technology report, January 13, 1989

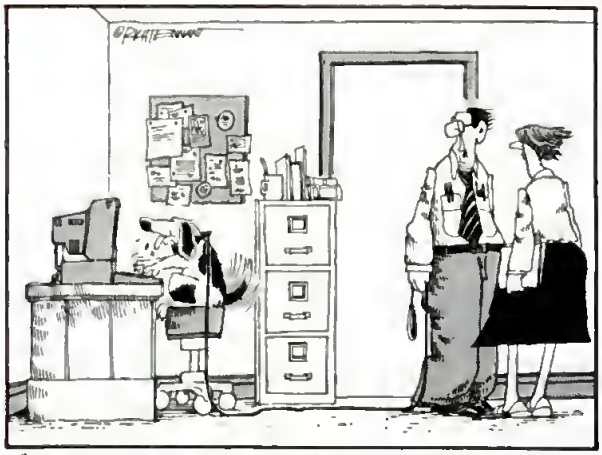


Technology marches forward: The old Software Publishing disk drive restricted you to transparencies. (The Corning *(N.Y.)* Leader, *July 12, 1988)*

Wilde: I Wish I'd Said That. Whistler: You Will, Oscar, You Will

According to columnist Jerry Pournelle in *InfoWorld* (March 13, 1989), Microsoft's perceived plan to promote a 386-specific version of OS/2 over today's OS/2 286 "conforms to my prejudices. Last year I said the 286 was a brain-damaged chip. This year Bill Gates used that phrase."

To give credit where it's due, "brain-damaged 286" dates to 1987, when *PC Magazine* editor Bill Machrone keynoted the OS/2 Developers' Conference and thus described the 80286.



"NAAAH - HE'S NOT THAT SMART. HE WON'T BACK UP HIS HARD DISK, FORGETS TO CONSISTENTLY NAME HIS FILES, AND DROOLS ALL OVER THE KEYBOARD."

Have you seen anything offbeat about the computer industry? Send submissions to Communiqués, PC Magazine, *One Park Avenue, New York, NY 10016. Don't make marks on submissions. Contributors receive $50 and a* PC Magazine *T-shirt.*

Winners this issue include. Roger Steadman (disk drive slidemaker), Stephen Shore (SQL), Theresa Najita (mea culpa).

Illustration: Richard Tennant

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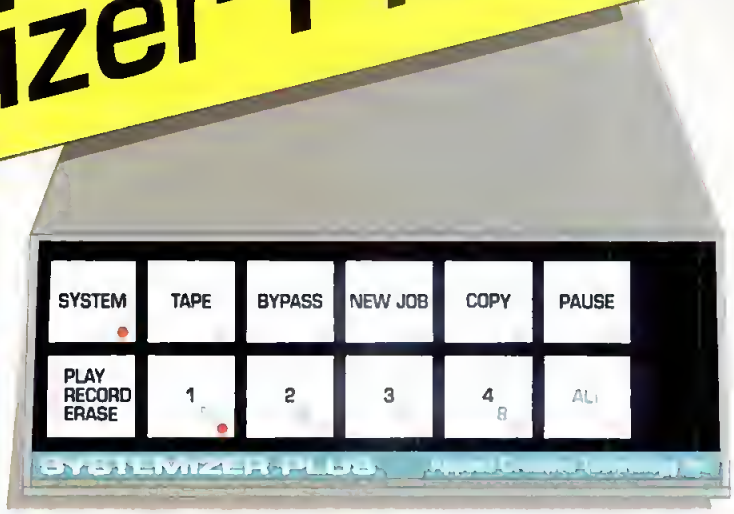
The Ultimate in Connectivity!



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- Share a Modem
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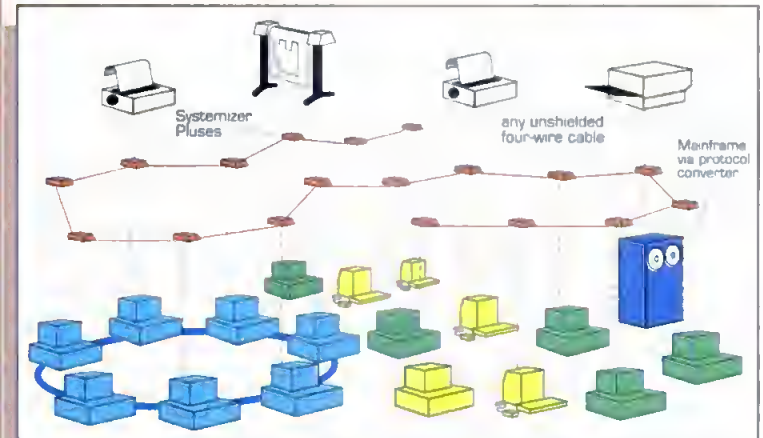
- Exchange EMAIL
- Transfer Datafiles



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CIRCLE 477 ON READER SERVICE CARD

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Adam Green, *Contributing Editor, Data Based Advisor, dBASE Author:*
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CIRCLE 112 ON READER SERVICE CARD

■ BILL MACHRONE

THE THRILL IS BACK

In the world of laptop computers, there's a definite pecking order. The Radio Shack Model 100 is chicken feed and the NEC UltraLite rules the roost.

I first started carrying a laptop in the summer of 1983. That machine was, of course, the Radio Shack Model 100. It was my constant companion for nearly 6 years. Until last fall, virtually every column and article I did for *PC Magazine* was written on that machine. It kept me in touch on three different continents through MCI Mail. It logged enough frequent-flyer miles to qualify for round-trip tickets anywhere in the solar system. It was x-rayed more often than Joe Montana's knees.

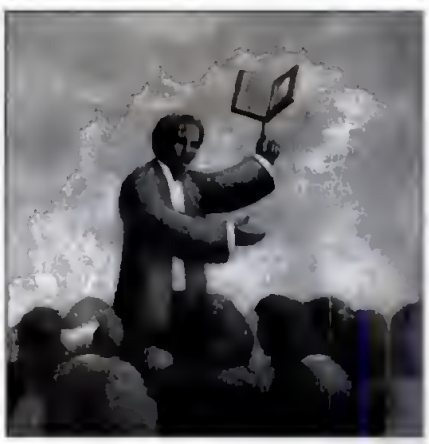
The Model 100 caused a furor wherever it went in those early days. On the train to New York one day, a man leaned across the aisle and asked, "Is that a *computer*?" He regarded it and me with suspicion for a moment, and then asked in a stage whisper (so the computer wouldn't overhear, I presume), "What's it *telling* you?"

A woman on a coast-to-coast flight spied me working away in my aisle seat and deduced that I was a writer or an editor. She proceeded to tell me her life story: her divorce, poems she'd written about her dentist, the challenge of being a suburban matron in the latter part of the 20th century, and more. Flight attendants worked around her as she went on. I prayed for turbulence and a seatbelt sign. They never came. An hour later, I finally got back to my work. The man next to me, having feigned sleep so that he wouldn't have to get involved, opened one eye and said, "If you'd just carry a calculator like normal folks, that wouldn't happen."

NEW RESPECT In the last few years, however, those awestruck expressions on the faces of the uninitiated have been replaced by the patronizing looks of computer-savvy passengers on planes and trains. The Model 100 isn't a serious machine in the minds of serious users.

Now that the NEC UltraLite is my travelling companion, I'm getting raised eyebrows and approving looks. I'm also getting questions just like the good old days. Wow, an UltraLite! Is the keyboard really OK? How's the battery life? Where can I get one? How much does it cost?

The first time I used an UltraLite on an airplane, it caused a small commotion. It was a prerelease machine, so I couldn't answer any questions about it. But my fellow passengers couldn't help noticing its diminutive size, sleek styling, and backlit screen. One guy looked at his big Zenith, then at the tiny UltraLite, and asked, "How long do I have to wait?" The guy across the aisle watched enviously while I slipped the UltraLite into a slim leather portfolio as he wrestled with the carrying case for his Toshiba 1200HD.



When I first saw the Model 100, I called it The $795 Cure for Loneliness. Times have changed, prices have risen, but the effect of the laptop remains the same.

EXECUTIVE GADGET When we did a First Look on the UltraLite, we called it a "laptop for the executive set," and that's certainly proving true (see "NEC's 4.4-Pound UltraLite Sets a New Standard for Portable Machines," *PC Magazine*, November 15, 1988, page 33). Lotus's Jim Manzi and all his vice presidents use UltraLites, mostly as portable *Agenda* machines.

One of the criticisms leveled against personal information managers is that they're of little use unless they're always with you. A lightweight laptop is the hardware embodiment of a PIM: you can take it anywhere. The UltraLite is no larger or heavier than a full-size Day-Timer. And, as Lotus's Bob Frankston says, it's not a write-only medium.

Other manufacturers have cast covetous eyes on the UltraLite's market, but they'll have an uphill fight against NEC. As I use the UltraLite more, I become increasingly convinced that it will retain market share even against equally light laptops with 2-inch floppy disk drives and lower prices. NEC's silicon hard disk dishes up performance and instant file saves that no floppy can hope to match. Besides, would you tolerate a Day-Timer if lights flashed and disks whirred every time you made a note or tried to find something?

Illustration: Rob Colvin

"RAM-Resident" Is No Longer A Dirty Word.

Remove, Replace, Even Deactivate RAM-Resident Programs *Without Rebooting* Your System!

If you use RAM-resident programs such as spell checkers, desktop organizers,

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PopDrop will support expanded memory (EMS), so you can manage the "new-generation" RAM-resident programs like *Sidekick Plus, WordPerfect Library* and *VCache*. And PopDrop also allows easy removal of popular network software.

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PopDrop works by dividing your memory into layers (up to 16), each of which may contain several progams. After loading DOS and your application programs, RAM-resident programs are loaded with these layers between them, the most permanent at the bottom, the least permanent at the top.

You can create batch files to remove layers one at a time, or several at once.

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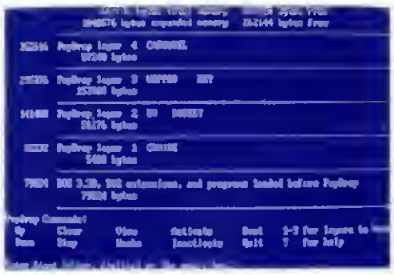
PopDrop Keeps Tabs On Your Memory Usage

Our unique "PopView" screen feature displays exactly how much memory is being used—you'll never see another "Insufficient Memory" message.



The PopDrop "PopView" Screen. From here, you can see which programs are loaded, how much memory each consumes, and how much is free.

Control Your RAM

If you want to run a RAM disk, a print spooler and one or more pop-up programs most of the time, but need them out of the way to work on a large spreadsheet, you can do it easily with PopDrop. You can also "activate" and "deactivate" programs in a specified layer of RAM that may conflict with the program you're using.

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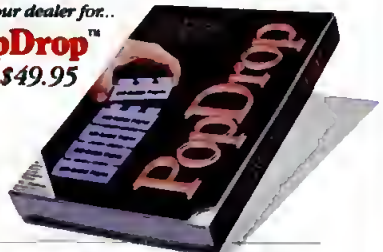

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■ **BILL MACHRONE**

The UltraLite is a design tour de force, squeezing more computer into less space than ever before. While no computer is perfect, using the UltraLite daily hasn't uncovered any major flaws other than the obvious ones mentioned in the initial review. For my daily commute, battery life is no problem. A little less than an hour's working time each way puts me right at the edge of the machine's battery life, but then it has all night to recharge. If you don't use the UltraLite on a commute, the 2-hour life is enough for frequent use throughout the business day, especially if it can recharge over lunch. For my transcontinental commute, 2 hours isn't enough. NEC won't sell you a spare battery pack because it doesn't consider the battery to be user-replaceable. A ham-handed user could, in fact, damage the main circuit board. I can't tell you where I got a spare, but it's a godsend and I'm being *very* careful.

The production model gained a pop-up setup program in ROM that wasn't in the first unit I tested. It controls backlight brightness, color-to-LCD display conversions, and other odds and ends. Utterly lacking are control over the cursor blink and keyboard repeat rates. I harnessed the former with SkiSoft's *No-Squint Laptop Cursor*. I find the standard repeat-key rate to be intolerably slow, especially in moving the cursor; here, a classic *PC Magazine* utility came to my rescue. QUICKEYS consumes only 672 bytes and works like a charm. You can download it from PC MagNet, and it works for almost any PC or XT compatible. Microsoft's *MS-DOS Manager* is one of the 455K worth of DOS programs and utilities hiding as drive D: in the UltraLite's ROM, but I don't have the patience for it. I use Michael Mefford's *PC Magazine* file utilities, RN and DR.

SOCIAL CHANGE The UltraLite and its eventual competitors will change the way computers are perceived and used by executives and managers. Today, in most quarters it's considered gauche to be typing while conversing with others, even if it's just to look up an item that contributes to the topic at hand. Nevertheless, we've all been in meetings where the participants read their mail. Old attitudes die hard, but the UltraLite will help change them. It has a rightful place in the revolution. PC

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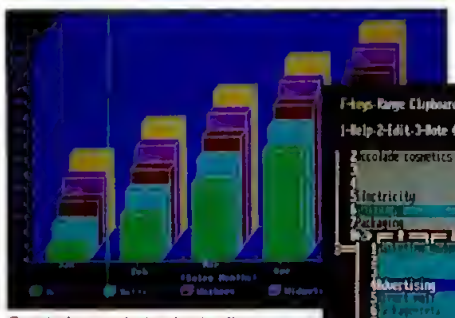

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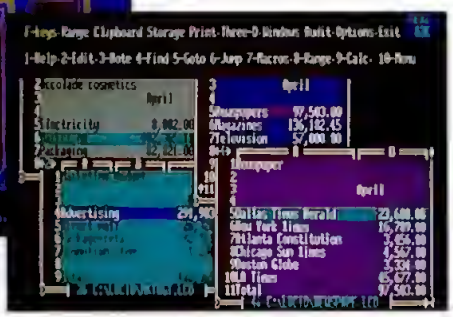

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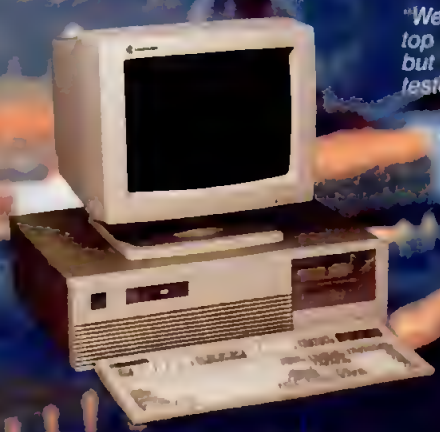

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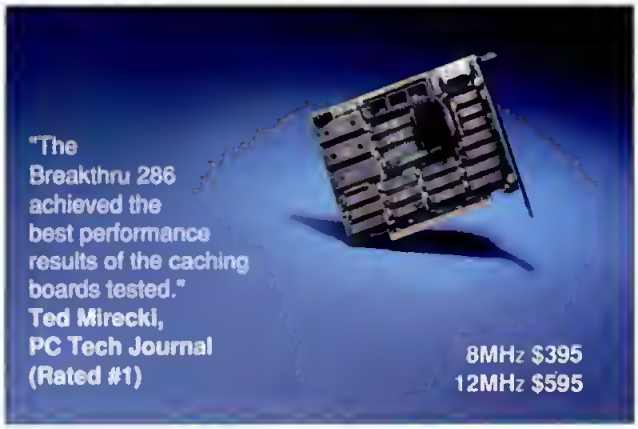

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■ JOHN C. DVORAK

THE SUN CLONE ALSO RISES

By encouraging others to spawn SPARC machines, Sun hopes to clone the success of the IBM PC. But without Big Blue's marketing prowess, Sun may lose out to the new breed.

"It seemed like a good idea at the time." Those are the words, I'm afraid, that Sun Microsystems will be repeating in a couple of years to defend the bet it's placing today—a gamble that will affect us all.

Sun is trying to encourage other vendors to clone its pricey workstations, especially the SPARCstations. It doesn't take too much research to unearth the company's peculiar scheme. A recent visit to the offices of BIOS cloner Phoenix Technologies revealed a presentation Phoenix is making to cloners for its services. Phoenix hopes to cash in big on a future world of Sun clones.

Sun decided that the popularity of the IBM PC was greatly enhanced by its early "open" architecture and the subsequent cloning and popularizing of the PC design by everyone who could piece together a few boards. The bandwagon effect made everyone rich.

Sun is hoping that if the same bandwagon effect takes place around the Sun machines running an updated Unix and based on either the Motorola 680X0 chip family or the Sun-designed SPARC chip, then the market will blossom for personal workstations. In fact, the workstation company figures that the market will explode and make Sun a corporate behemoth—even if its actual market share diminishes. It will be just like what happened with the IBM PC—even though IBM's share of the PC market shrank, its revenues grew fantastically.

It sounds like a good idea, doesn't it? Well, maybe as a desperation move. This idealized marketing concept is almost laughable, and I think we should all get ready for a big belly-laugh.

Sun's model for future success ignores too many facets for me to pass it by without comment. First of all, IBM never intended the PC scenario to happen the way it did. Big Blue didn't even like the results and has changed its strategy to prevent its happening again.

Note: Above all, IBM is a marketing company. Sun is a techie-nerd company with little, if any, marketing prowess. Therein lies the rub. I once told a friend that the way Sun sells its computers is to have some guy follow a DEC salesman around and visit the same companies, armed with a better deal and the Sun "open systems" pitch. That strategy works fine with DEC accounts. But ask Sun how retail sales are doing for its 386i machine. "What retail sales?"

Also, Sun doesn't make a plug-and-go machine. It takes a lot of work to get a Sun running. If Dell or CompuAdd, for example, cloned a Sun and added some user-friendly notions and a cut-rate price, then who would buy a Sun?

The basic mistake Sun makes with this concept stems from the same arrogance exhibited by DEC when it entered the PC world with the now-defunct Rainbow. Digital assumed that people would buy the Rainbow because it was made by DEC, a world-famous company. World famous? Who, except people in the computer business or customers who are already using a VAX, has ever heard of DEC? Ask your mother if she's ever heard of DEC. Ask your mother if she's ever heard of Sun. Then ask her if she's heard of IBM. See what I mean?

I'm greatly amused that Sun has the collective ego to imagine—even remotely—that it can copy the IBM PC's success with a similar, but overt, marketing ploy. I'll tell you, it sure misses the point. It's kind of like watching Arnold Schwarzenegger win the Mr. World contest and saying to yourself, "Gee, if I wore those tight red shorts, I could win that contest too!"

If a wave of Sun-clone workstations comes into our lives and leads the way to new computing power, then you can be sure of one thing: Sun will be the loser as it gets undersold, undercut, ripped off, and outmaneuvered by the faster gunboats now playing in the world of the PC. Sun has been basking in the lazy netherworld of the minicomputer customer. They don't know what hardball is all about. Hey, but I like the machines. I wish them luck.

Illustration: Rob Colvin

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■ JOHN C. DVORAK

INSIDE TRACK

The death of assembly language; uninterruptible power.

It's no coincidence that the popularity of C and other high-level languages comes at a time when an influx of **incompatible microprocessors** is headed our way. By incompatible microprocessors, I mean the RISC chips: SPARC, MIPS, 88000, and i860, for starters. According to industry pundit George Morrow, this influx of chips will worsen, and it's all a result of Motorola and Intel's decision to cease second-sourcing the 68000 and 386/486 chips. Morrow, once the head of Morrow Designs, a **defunct** CP/M computer maker, knows that all manufacturers get nervous if they don't have more than one source for their required parts. The thinking goes that today's manufacturers will **flock** to a new microprocessor that is easily available from many sources. We can expect a **deluge of different processors** all claiming to be the chip of choice. Most of them will use the easy-to-design RISC architecture. RISC-mania has gotten so crazy that Intel and Motorola joined the fray unaware of the consequences.

Doomsday scenario: As soon as more than two processors become popular, assembly language code writing will die. It will be in the best interests of programmers to write programs in high-level languages that can be ported. This trend has been predicted for years, but the small number of mass-market platforms and memory limitations, combined with **slow processor speed,** have kept assembler alive. All of these factors will change. In chaotic times, uncertainty itself demands high-level language coding. "They went broke? OK, I can port to something else tomorrow!" This is very much a newer, **weirder version** of the desktop computing market of 1977.

Ask Microsoft, Borland, or any other seller of high-level languages; they'll all tell you that the language business, specifically C and Pascal, is **hotter than ever.** The boys at Symantec are stunned by the sales of the Lightspeed products that the company acquired. Assembler is **going down** fast. Once it dies, then the importance of the individual chip with its peculiar instruction set will diminish. All that will count will be performance and price. Do you see the **vicious circle** here? Tough sledding ahead for Intel and Motorola.

(Meanwhile, I'm waiting to see what happens when someone rolls out the chip of chips: **a bit-slice RISC transputer chip with built-in floating point, cache, and digital signal processing.**)

Scorn the Users Dept.: I've never seen a phenomenon quite like this. Last year System Enhancement Associates (SEA) and PKWare got into a **legal battle** over the use of the .ARC file extension, which SEA claimed was its property. SEA invented modern micro ARChiving software. Over time, Phil Katz at PKWare developed archiving and dearchiving software that many users preferred. He also made the stuff compatible with the SEA.ARC format. Software from both companies worked with each other's files nicely. Then came the suit. Well, **SEA won the legal battle,** and PKWare was **forced** to stop providing compatible dearchiving software and couldn't archive a file with the SEA format and the .ARC extension.

Boy, did this make truckloads of BBS sysops **steaming mad.** Phil Katz went to work and developed a system called **ZIP.** A slug of programmers wrote programs that converted the tonnage of .ARC files into .ZIP files, and now .ZIP appears to be the new standard for shrinking and archiving programs and documents. The BBSs around the country have **simply rebelled** against the legal action taken by SEA. The thinking goes thus: "We're all in this together, and we can all profit if someone doesn't get greedy." SEA was perceived as greedy. In my years as a student at Cal Berkeley, I saw **riots and boycotts and sit-ins** of all sorts, but this is the most interesting grass-roots boycott movement I've seen yet. The boys at SEA think it will pass. I'm not so sure. My advice to those of you who rely on software to shrink and archive files: Get a copy of **PKZIP.** (You'll find it on most BBSs and CompuServe.) This is a case where the loser of the lawsuit **profited immensely** from the publicity and public sentiment. The instigator of the lawsuit seems to be temporarily, at least, damaged. **Lotus, Ashton-Tate, Apple, and other litigious firms** should examine this phenomenon.

The Mature Computer User Dept.: It was Stan Hayes of Ad Works in Atlanta who talked me into doing something I've resisted for years: adding an **uninterruptible power supply** (UPS) to my computer system. I'm now pleased as punch, especially since the thing already saved one file during a very short **power outage** caused by a storm. And the next time there's a blackout, I can unplug the computer, plug in a 150-watt lamp, and keep the room lit for nearly an hour. These things are actually **fancy batteries** with all kinds of power conditioning and regulating circuitry. Who needs surge protection with one of these babies online? If you're running a network in rural Anyplace, U.S.A., you need a UPS, **let's face it.** Even without LAN or rural **paranoia,** these things are generally a good idea. I was loaned the Taesung (TSi) Industries 3160H, made by Samsung and sold by TSi of Alpharetta, Georgia ((404) 664-8944). It's flawless and surprisingly compact. Expect to pay $350 to $450 for one of these units. Highly recommended. PC

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[1]Applications supported in SpeedView include Lotus 1-2-3, Symphony®, Manuscript®, Agenda®, WordPerfect, dBase®, MultiMate®, Microsoft® Word, WordStar®, DisplayWrite, all ASCII files, plus many more

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ard disk because at you're looking for?

they appear in your favorite applications.

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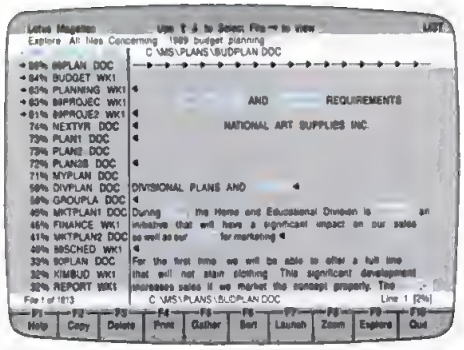

The Magellan Explore and SpeedView functions let you locate everything related to a particular topic and see it as it would appear in its native application.

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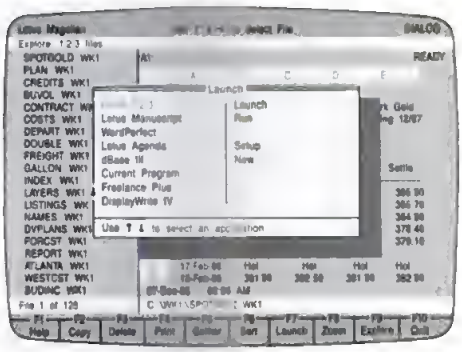

With one keystroke, Magellan loads the selected file and application, in this case 1-2-3, so you're ready to go to work.

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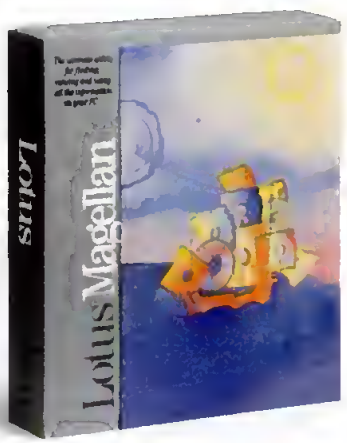

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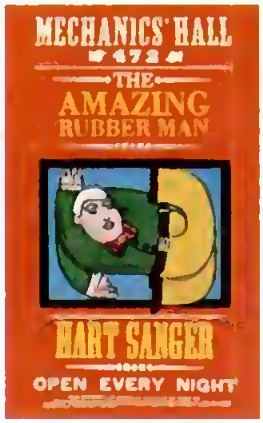

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■ JIM SEYMOUR

THE WINDOWS TEST

DOS is going to stay in charge for some time. But to make up for its shortcomings, we've got to find a good second-in-command. Can Windows meet the need? Well, maybe.

People with strong views on The Future of Personal Computing often get caught up in arguments that focus on the wrong issues, or in apples-and-oranges comparisons that provide heat but shed little light.

One example of these inapt comparisons is found in the debates over whether DOS or OS/2 will be the next-generation power-user operating system for IBM PCs. The flaw here lies within the question. The issue isn't really DOS vs. OS/2, but Unix vs. OS/2.

HERE TO STAY DOS is going to be around for a long time. The idea that we're all going to wake up some morning soon, decide we can't live with DOS any longer, then feverishly clutch OS/2 to our breasts, has been thoroughly discredited—in these pages and elsewhere.

Let me set aside OS/2 vs. Unix for another column. Whatever the outcome of that battle, DOS is going to remain important and—for at least several years to come—dominant.

What I wonder about is the form in which we'll use DOS. I see DOS undergoing a metamorphosis. While DOS will reign well into the '90s, it's not going to be DOS as we know it today. It's going to be DOS Plus Something. The interesting question is, DOS Plus *What*?

INEVITABLE INTERFACES Part of the change—but only part of it—will be the inevitable migration toward graphical interfaces. Most "Is DOS Dead?" analyses make too much of this: many of us neither need nor want graphical interfaces for most of our work . . . at least not at this time.

Few *WordPerfect* users, for example, are ready to give up the clean look and snappy performance of their favorite word processor just to get pointing and clicking. Ditto for users of *dBASE*, *Paradox*, *1-2-3*, and many other widely used PC applications.

But I call that migration inevitable because, as more programs appear that were designed from the ground up to be used graphically, more of us are going to be seduced by the legitimate charms of the graphical interface.

Another deficiency is memory management. Clearly the days of the 640K barrier are limited. Now we have so many ways to make end runs around 640K—from EMS and EEMS memory boards to such control programs as *Windows/386* and *DESQview*, from memory managers such as *386-to-the-Max* to hardware workarounds such as the All Chargecard—that no one who really needs more memory need stay within that limit.

The third gap that needs filling involves ease of use. As the DOS market has expanded downward explosively over the past 3 years, lots of people who have been swept into the PC-compatibles world refuse to put up with the stupidities of DOS's command-line interface and syntax.

They're right, of course: those of us in the grizzled-veterans camp learned to put up with DOS's shortcomings only because we're zealots. But personal computing is becoming a mass phenomenon, and zealots don't make mass markets.

So what looks like the winner?

THE MULTIPANED FUTURE The easy choice, the one I *want* to say will be the winner, is *Microsoft Windows*. I like many things about *Windows*. But even in its latest versions, it is still operationally clumsy, as well as being a performance burden.

Windows, which—among other failures—requires navigation through long lists of filenames, falls far short of a true graphical interface. And though *Windows*' performance improves with fast 286 and faster 386 PCs, a winning DOS-Plus-Something product is going to have to work well enough on 8088/8086 machines, too.

Some of the pundits in the industry predict 1989 will be The Year of *Windows*, when a critical mass of us succumb to its

Illustration: Rob Colvin

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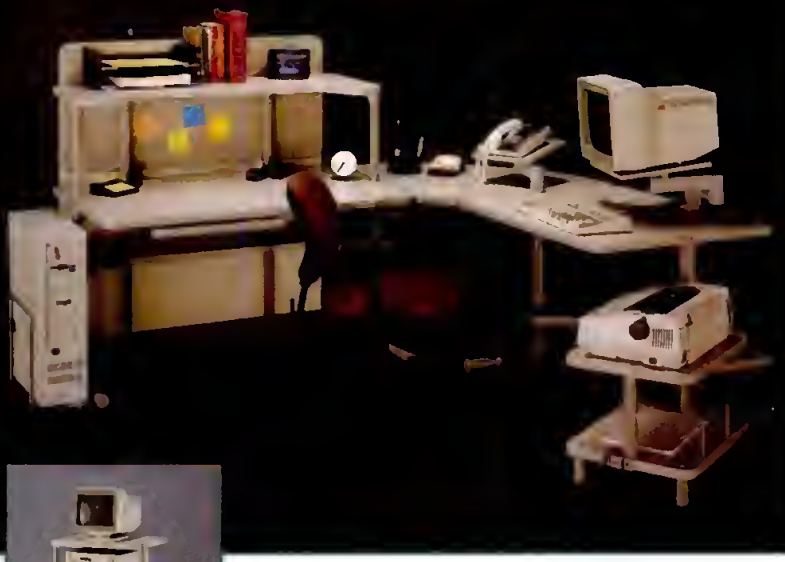

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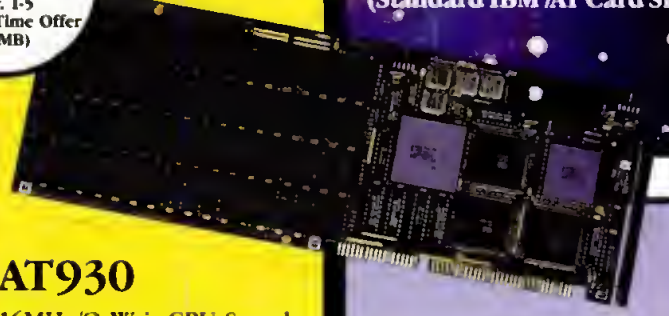

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■ JIM SEYMOUR

charms and migrate into the multipaned world of the future.

For some time, I have been positing a test as a leading indicator, or early predictor, of that moment. That test is simple: I'm looking for people who've begun using a mainstream *Windows* application—say *Microsoft Excel*, or maybe Aldus's *PageMaker*, or *Micrografx Designer*, or another native, no-choice-about-it *Windows* product—and have decided that they like the *Windows* environment so much that they want to stay inside that world and start searching for other native *Windows* applications to round out their basic applications-software tool kit.

I've come to know a lot of perfervid users of *Excel* and *PageMaker* and *Designer*, but not many who've decided they want to stay in *Windows*. Some use non-*Windows* apps full-screen sometimes, and occasionally run even more than one non-*Windows* app at a time, in tiled or overlapped *Windows*. But as much as they may like *Excel* or *PageMaker* or *Designer*, these "leading-indicator users" typically exit *Windows* and work in a straight DOS environment with their other programs.

Since those three programs are so good—if you don't like *Excel*, it's hard to imagine that you have much enthusiasm for any business software on the PC!—you'd think they'd have the effect of promoting *Windows*, pushing people along the path toward adopting or trying to adopt the *Windows* world as *their* world.

But that hasn't happened yet.

Such alternatives to *Windows* as *DeskMate*, *DESQview*, and *VM/386* are interesting but carry distribution, performance, or computing-power liabilities; they're unlikely bets for widespread use.

So I remain stumped as to what's going to become the winner in that DOS-Plus-Something market.

Clearly, the PC community has become a more pluralistic world over the past year or so; we support far more diversity than we did 3 or 4 years ago. Perhaps that pluralism will be the answer to the question, DOS Plus *What*?

The part I'm certain about is that DOS can't stand alone much longer . . . but is far too hardy to fall before the likes of OS/2. PC

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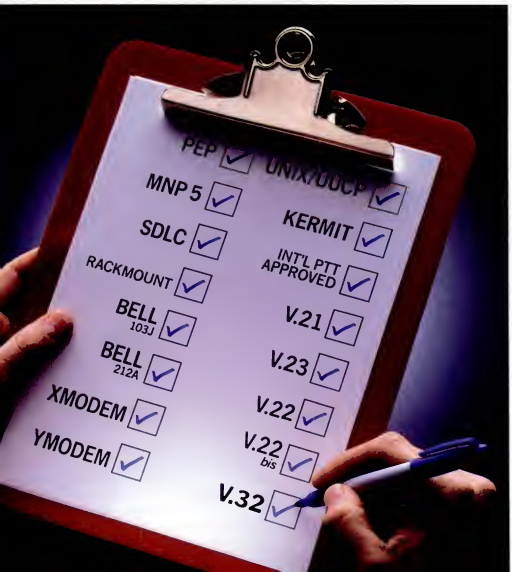

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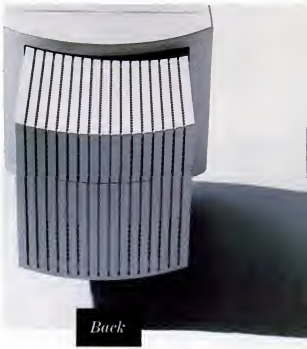

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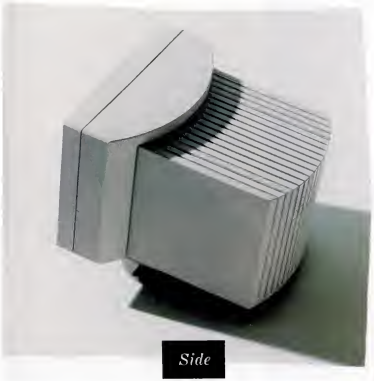
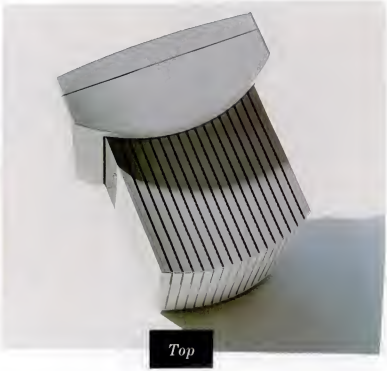


The way we see it, MultiSync 3D



has dramatically raised the standards by which all other color monitors will be judged.

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■ WILLIAM F. ZACHMANN

ADVENTURES IN CYBERSPACE

Journey through the cyberspace of on-line communications and meet the people who inhabit this brave new world. A PC and a modem will take you there.

In William Gibson's Hugo Award–winning 1984 science fiction book, *Neuromancer* (the ultimate hacker's novel), characters in a future world "jack in" to a parallel reality of "cyberspace." Somewhat like the hallucinatory but real worlds of the shaman in Carlos Castañeda's tales of the Yaqui Indian sorcerer Juan Matus, Gibson's cyberspace has complex (and potentially deadly) intersections with the ordinary world of experience.

CLOSE ENCOUNTERS After many months of spending 2 or 3 hours a day reading and sending messages on PC MagNet and CompuServe, I have been struck recently by the degree to which intense immersion in on-line communications evokes aspects of the cyberspace world that Gibson describes. Just as Gibson's characters encounter one another sometimes in cyberspace and sometimes in ordinary reality, one encounters others in the on-line world as well as in real life. There are even people I've encountered almost daily for weeks now whom I have never met—except electronically in the form of ASCII text strings.

If graduate departments of sociology or anthropology were on their toes, they'd be doing studies of this emerging electronic society. It isn't often that one has an opportunity to be a participant/observer in a radically new form of human society. What makes it even more interesting, however, is that new cyberspace communities like PC MagNet's are almost certain to become a normal part of human life as we approach the year 2000.

Already, electronic information services, electronic-mail systems, and bulletin boards are in daily use by hundreds of thousands of people. In addition to major services like CompuServe, MCI Mail, Dow Jones News Retrieval, The Source, and others, there are hundreds of small local bulletin board services for various user groups.

With no more than a personal computer, a modem, a telephone line, and software like Fort Lauderdale, Florida–based Galacticomm's *The Major BBS*, anybody can create a cyberspace domain. And, indeed, more and more businesses and individuals are doing so all the time.

Yet all of this is barely the beginning. As even more-powerful PCs and communications capabilities become more widely affordable, large segments of the world's population will be able to meet one another and exchange information electronically in cyberspace.

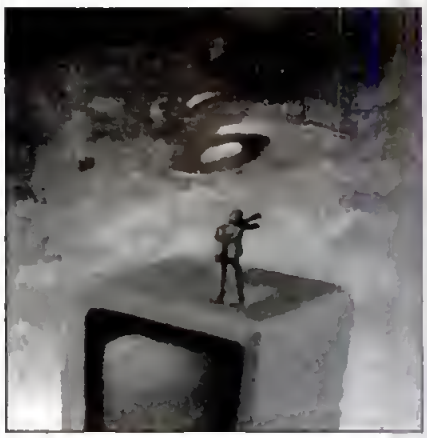

Illustration: Rob Colvin

MEET ME IN CYBERIA? Before the end of the next decade, high-school students from the U.S., Europe, China, Russia, and maybe even Afghanistan will be able to meet in cyberspace through computer communications. Businesses will routinely rely on international messaging and conferencing systems for coordinating their sales forces, for communicating with customers and suppliers, and for monitoring market trends.

In fact, the basic pieces are already in place for a major explosion in cyberspace use. The astonishing speed with which digital facsimile transmission has been accepted and has transformed the way business is done is an indicator of how rapidly things can happen once the time is right.

What's more, the stunning success of fax has very likely prepared the way for the acceptance of modem-based computer communications as well. Fax—by working its way into the local drugstore, accountant's office, and lumberyard—has awakened even small businesses to the potential of electronic communications.

With continued advances in modem technology making transmission speeds of 2,400 bits per second or faster readily affordable, signs of a major acceleration in use are mounting. And, although ordinary phone lines are limited by the 19.2-kilobit-per-second (uncompressed) upper limit of RS-232 communications today, the phone companies' promised Integrated Services Digital Network (ISDN) and eventual fiber-optic local connections are likely to raise those limits substantially in the future.

■ WILLIAM F. ZACHMANN

FORA FORAYS But even the current technology is enough to create entire communities in various parts of cyberspace. PC MagNet is typical of these. There, not only do more than 50,000 *PC Magazine* readers, writers, and editors exchange ideas, information, and opinions about industry topics, but they also discuss an enormous range of "extracurricular" topics such as music, philosophy, and politics. CompuServe forums (or "fora" as they are called in cyberspace) cover as wide a range of topics as there are people willing to participate in them. Whether your interest is fine wines, race cars, religion, investments, comic books, literature, the law, or scuba diving, there is a forum for you. And if you are interested in an area for which a forum doesn't exist, you can probably convince CompuServe to set one up, provided there are enough other folks willing to use it.

If you're a cyberspace traveler already, you know what I'm talking about. If you're not, then you are missing out on a terrific opportunity to participate in the early development of the information age.

'BURBS: THE SEQUEL Modern electronic-information services are creating literally a new dimension of society. The communities that form in services like PC MagNet and CompuServe are just as much a part of the future evolution of modern society as were the movements from the farms to the cities early in this century or the development of the suburbs after World War II. The difference is just that the newer communities are developing in the cyberspace of digital electronic communications rather than in the physical space of real estate.

■ Whether your interest is race cars or religion, there's a CompuServe forum for you.

The exciting thing about this latest migration, however, is that anybody can participate without leaving the office (or home). All that is required for a modern cyberspace traveler is a personal computer with a modem. And, unlike Gibson's cyberspace world or Castañeda's world of the shaman, the possibilities of mortal danger are extremely small. The risks one takes are the more ordinary social risks of encountering a new group of people in a most novel and unusual manner! PC

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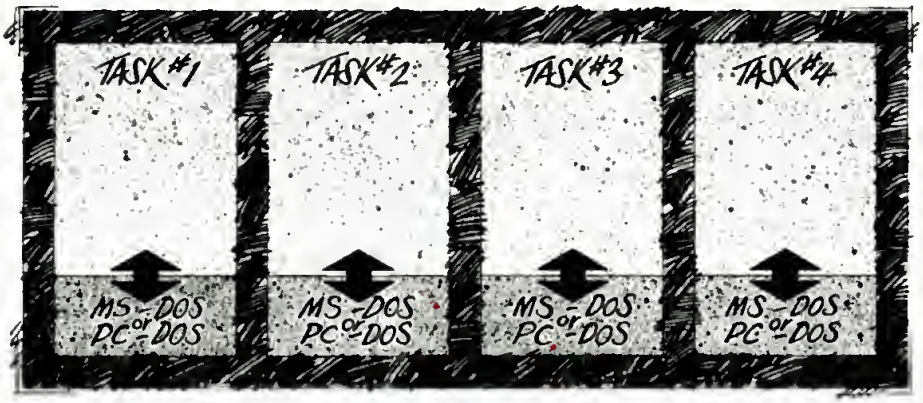
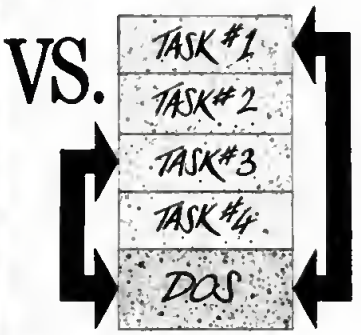
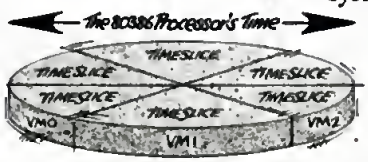
With VM/386 Multitasking, Each DOS Stands Alone





Unlike multitasking environments which force each task to share one copy of DOS, VM/386™ is the only 386 control program which provides complete task independence. With our virtual machine architecture, designed specifically for the 80386 microprocessor, you can even crash and reboot an application—without affecting any of the others. Richard Eckhouse of IEEE Computer said "Unlike other such systems, VM/386 not only works well, but seems to be unbreakable."

Each virtual machine is just like a stand-alone PC, complete with its own copy of PC-DOS or MS-DOS (the real thing, mind you, *not* an imitation). So each virtual machine in your multitasking environment gets its own terminate-and-stay-resident (TSR) programs, AUTOEXEC, and CONFIG files.

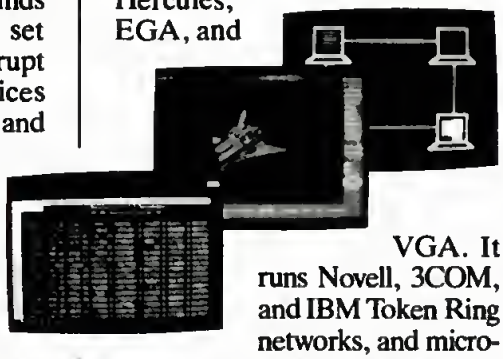


As Namir Clement Shammas said in our Byte review: "VM/386 provides you with excellent control for adjusting the performance and operation of each virtual machine."

VM/386 gives you other kinds of flexibility, too. You can set I/O privilege level and interrupt priorities so multiple devices can be run simultaneously and efficiently. You can adjust the amount of memory used by each application, including extended and expanded memory. VM/386 even eliminates "RAMcram," because you load each application in its own virtual machine.

And, most importantly for anyone trying to control complicated systems, you can adjust time slices down to the millisecond level. Developers are using this feature to update virtual machine performance "on the fly."

Another significant capability of VM/386 is the ability to run graphics and communications programs full-time in the background. VM/386 supports MDA, Hercules, EGA, and VGA. It runs Novell, 3COM, and IBM Token Ring networks, and micro-to-mainframe communications.



Why wait for a "new" operating system, and its inevitable compatibility and "first-release" problems? With VM/386, it takes only a few minutes to set up a fully-configurable, DOS-compatible multitasking environment on your 386.

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■ STEPHEN MANES

ANY DAY NOW: ENGINES OF THE FUTURE

There's nothing like buying a highly touted "platform for the future"—especially if the platform rusts out before the future arrives.

"I'm looking for a vehicle," Dad told the salesman at Hondler Motors. "What's the story on this one?" The Chivey Gorp that Dad was pointing to had the lowest sticker price in the place—and was still no bargain.

"Good transportation," the salesman said disdainfully. "All new this year, bumper to bumper."

Dad went over and opened the hood. "New? This is the same underpowered 88 cube engine you've had for years!"

"Look closer. It's actually a super 86. Extra valves," the salesman puffed. "Sixteen instead of eight."

"So that'll do what?" Dad snorted. "Make it go 56 mph instead of 55? And the body's narrower than it used to be. I could never get this fat butt of mine in."

"Easier to park." The salesman smirked. "But when you get down to it, you're absolutely right—the Gorp is not state of the art. Come take a look at our new line of III cars. Here's our Chive-au-lait III."

"Looks like one of last year's models—what was it, the Luger, the Daisy, the Spud Pistol?—only smaller," Dad jested.

"Downsizing is a reality we all have to live with," the salesman sniffed. "But this III car is different in every possible way."

My father rolled his eyes and cracked the hood. "This has the same lousy 286 motor that's been around for years."

BUILT-IN OPTIONS "But it's driving a whole new platform for the future. First, look at this sticker: lots of options are built right in. Last year, a temperature gauge was an extra-cost option; this year it's standard. Last year we charged extra for the map light; this year it comes in every III we sell."

"Thrilling," Dad said impatiently.

"That's just the beginning." The salesman reached into the car and tugged at the steering wheel, which came right off. He held it up like a trophy. "Modularity. That's the vision. Every available option just snaps in. You can customize it exactly the way you want. If you change your mind, you can make adjustments in seconds. You don't need a wrench. You don't need a screwdriver."

"And neither do the guys who swipe parts," Dad retorted. "How often do I change steering wheels, anyway?"

"That's not our real selling point," said the salesman, unruffled. "*This* is." He opened a little flap on the rear deck.

"What is it?" Dad asked.

"The Macro Connection Link." The salesman beamed. "MCL. There's another socket up front and two more inside."

"What does it do?"

An MCL brochure magically appeared. "All the details are here. In the future there are going to be only two kinds of cars: those with MCL and those without it."

"But what's it for? What good is it?"

"I'm sure you realize that Generic Motors has one of the largest R and D operations in the free world. The MCL means your car is ready to hook up to any new development that comes out of the labs."

"Like what?"

"The only limit is imagination." He pointed to a picture of an impending head-on collision. The Chivey III had high-tech rays flashing out from it. "This is a special superconducting magnet that repels oncoming cars in the event of a collision. Without MCL, you'd never be able to add it to your car. With MCL, you'll just hook right into the new technology."

Dad whistled. "Now that really is something. How much does that cost?"

"Impressive, huh? My kid calls it Star Wars."

"How much?"

"Still in the labs, I'm afraid."

Dad frowned and looked down at the brochure. "What's this? Wings?"

The salesman beamed. "Imagine rush-hour traffic. Our Aero III module will take you from zero to 60 feet up in 20 seconds. But not with low-end models like the Gorp. It will only plug into the MCL."

"You're telling me this gutless 286 will be able to generate enough power to fly?"

Illustration: Rob Colvin

■ **STEPHEN MANES**

"Well, that's not guaranteed. You might need one of our 386s for acceptable performance."

"But I could plug that in later on. It's modular, right?"

"I think you misunderstood. The engine is definitely not removable. That's why we suggest you consider the bigger models if you're thinking about something like the Aero down the road."

"Is this Aero thing available now?"

"It's in the experimental stage. But I suspect you'll be seeing it before the turn of the century."

"The turn of the century! That jalopy will have rusted through by then!"

"Not if you have our MCL-based ion-generation rust protector."

"What will that do?"

"It will bathe your car in an invisible shield of ions that will prevent rust before it even starts."

"How much will that cost me?"

"When we bring it to market, you can bet it'll be highly competitive."

"Look," Dad growled, "what can this MCL do for me right now, today?"

"It protects your investment in automotive technology from becoming obsolete."

"Speak English. What plugs into these MCL outlets, anyway?"

"There are dozens of MCL options. Radios. Car phones. Digital clocks. And with MCL, you can use them all at the same time without degrading performance!"

"I can get those on any car and they already work just fine all at once. Are these cheaper, or what?"

The salesman coughed. "I believe you'll find them fairly priced, considering their value."

"In other words, expensive."

The salesman gagged. "Uh, yes."

It was pretty much the same at the Kreutzer and Dorf showrooms. You could get the old low-end cars they'd been churning out for years, or "Cars of the Future" with something called "FICA."

As far as Dad could figure, FICA was just like MCL, except you could plug in the digital clock or radio, or even the spark plugs, from your old trade-in. But nobody was actually doing that, in part because dealers found it was tough to sell used cars with big holes in their dashboards, and in part because you had to get on a waiting list to order FICA cars—they weren't available just yet.

So Dad ended up with a car that looked exactly like his old clunker. The Chopstick is dependable and so cheap Dad could afford a hot 386 engine—after all, it came from Taiwan.

Dad doesn't seem to be real worried that his trade-in value will be affected by Cars of the Future. But he is a little concerned about rumors that standard equipment on next year's Chopstick will include a monster 486 under the hood. PC

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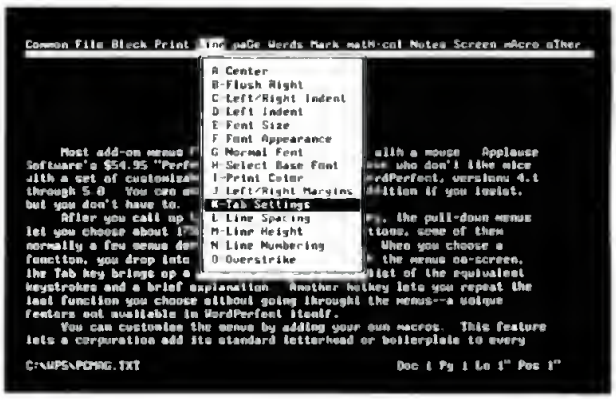

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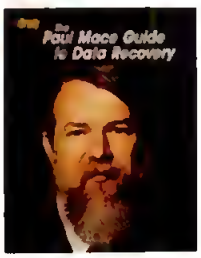

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COVER STORY

80386

THE POWER AND THE GLORY

For price, versatility, and sheer power, the 80386 microprocessor, more than any other chip, fulfills today's expectations and leaves plenty of room for the demands of tomorrow. PC Magazine's editor-in-chief Bill Machrone explains the magazine's backing of the best microprocessor yet—and why there's no reason left to look elsewhere.

As you read this, let's join in a moment of silence for a dear, departed friend, gone before his time. It wasn't easy for the little guy, born, as he was, brain damaged. But he and millions of similarly afflicted brethren enriched our lives despite their tragic limitations. They nearly overcame the odds. But in the survival of the fittest, the inevitable happened. They were pushed aside—killed, as it were, by their own parent, Intel. Yes, the sad little 80286 never stood a chance.

Even as I write these words, however, thousands of 286-based machines are being purchased, many of them from the advertisements in this magazine. We've risked becoming tiresome as we repeat the litany: don't buy a 286-based machine.

Sure, the 286 did a lot of good computing for us. The original PC AT finally elevated the IBM standard into the realm of true 16-bit computing. It showed us what protected mode was all about. It proved that 8 bits were not enough for seemingly mundane I/O operations. It recalced our spreadsheets in one-third the time the old XTs took. But that was then; this is now.

In last year's August issue, the cover read "Why You'll Never Buy Another 286." That epitaph, you may know, touched off a hue and cry from readers and vendors alike. Readers claimed that we were too blinded by performance and too eager to get them to spend big bucks. Vendors claimed that we were unrealistic, that 286 machines were their biggest sellers. We in turn responded that it was OK to buy 286 machines back when we didn't know any better, but now it was like throwing good money after bad.

FIRST NAIL DRIVES HOME One nail in the 286's coffin is the 80386SX. This past January, Intel made dramatic price cuts in the 386SX. The debates continue over why the chip maker actually made the cuts and the nature of the 386SX's real role in the market.

Some claim that sales of the 386SX were so bad that Intel had to resort to fire-sale prices. Others say it was time for Intel to go after Harris and AMD (the 80286 licensees) in a big way.

At the SX's original pricing, it couldn't have been a success. There just weren't enough reasons to turn away from the 286, and it didn't lend itself to a new tier between the 286 and 386. But the SX's newly aggressive pricing is a success. Several compatibles vendors have already made plans to become 386-only manufacturers. The bottom-of-the-line machines will sport 386SX chips, with full 32-bit 386 machines at the high end.

PC Magazine columnist Will Zachmann calls 386SX chips "the castrati of computing," referring to the power of the 32-bit chip's being cooped up in a 16-bit package. In the market, however, it's working out a little differently. Whatever the reasons for the price cuts, the bottom line is that you can build a 16- or 20-MHz 386SX-based machine for essentially the same price as a 286-based machine. As the 386SX price drops closer to that of the 286, precious few differences remain between a high-end 286 and a 386.

Way back in 1987, editor Bill Machrone was already calling the 286 chip "brain damaged."

So why would you want a lesser, older chip? Yes, the 286 runs OS/2, but by the end of the year there'll be a 32-bit version of OS/2. Next year, Presentation Manager goes 32-bit. By then, OS/2 applications will be plentiful. And you'll be throwing rocks at your 286-based hardware because the benefits of running PM-based software on the 386 will immediately be apparent.

AN EARLY BIOPSY *PC Magazine* has been heralding the demise of the 80286 since my column in early 1988 ("80286 R.I.P.," January 26, 1988), but my unlove affair with the 80286 goes all the way back to summer 1987. At Microsoft's first OS/2 Developer's Conference, when I called the 286 brain damaged, the description drew applause from most of the audience and apoplectic looks from the Microsoft table.

My comments simply reflected the hard reality that the 386 is a far better chip for both today's and tomorrow's computing. The examples I gave at the time still apply: the 286 has no inherent way to switch from protected mode back to real mode; instead, the switching must be done by external circuitry that actually resets the chip without losing the work currently in memory. The switch can also be made by the keyboard controller, itself a low-powered microprocessor that can be programmed to seize control of the 286 as it resets. This is a kludge—which, in engineering parlance, is no compliment. The 286 further limits you to running one real-mode (DOS) task or multiple protected-mode (OS/2) tasks.

The 386 would also seem to be infinitely better suited for today by allowing multiple DOS sessions in virtual 86 mode. In truth, virtual 86 mode has been difficult to harness by operating system designers, who want to deliver more than purely independent DOS machines running on one chip. Users want interprocess communications in the form of a shared file system, clipboard, and messaging. In some ways virtual 86 mode provides too much isolation and not enough centralized control. As a result, the leading 386-specific software programs—*Microsoft Windows/386* and *DESQview 386*—don't use it.

The 386 makes up for the difficulties of using virtual 86 mode by offering comprehensive memory-management capabilities that are utterly lacking in the 286. It allows fairly sophisticated remapping of memory: a major convenience in getting various drivers, network monitoring programs, and memory-resident programs out of the 640K that you want to use. Today's multitasking operating environments, in fact, rely heavily on the 386's memory management to work their magic. So do memory-mapped devices like the Weitek math coprocessor chip set.

Finally, for those of you who thought that the 286's 16MB address space was going to be enough, it isn't. Even if you don't have that much real memory in the system, the 386 has comprehensive virtual-memo-

THE 486: ALL THAT POWER WITH NO PLACE TO GO

You may wonder why *PC Magazine* has devoted all this space to 80386-based PCs when 80486-based PCs are just around the corner. After all, the rumor mill is buzzing over Intel's latest attempt to put a mainframe on a sliver of silicon—and has been since soon after the first 80386 was announced. Many of those rumors are pretty solid by now. But don't hold your breath.

What you might've heard is that Intel won't be shipping 486s until well into 1990, and PCs built around the new processor certainly won't be available before then. Less known, however, is that when these *are* available, most PC users won't be able to take advantage of, or even afford, the new generation of PCs.

THE 486'S PLUS SIDE The hottest rumor of all is the speed of the 486. If you think that a 25- or even 33-MHz 386-based PC is fast, think again. Word is that the 486 is designed to run as fast as 60 MHz, roughly twice the current maximum speeds that 386 processors can manage. There's more: because no instruction is expected to require more than one clock cycle for the 32-bit 486 to execute (a 386 ordinarily takes one to three), a 33-MHz 486-based PC will run the same program about three times as fast as a 33-MHz PC powered by a 386 processor.

The 80486 will also increase processing speed by including an on-chip static RAM cache; the 386 requires the external 82385 controller and separate static RAM to accomplish the same thing. The 486's internal capability will improve performance by saving the time required to access off-chip RAM cache facilities.

And if you want even *more* speed, Intel is developing the N10 version of the 486. While the so-called RISC (reduced instruction set computer) version won't be PC-compatible, it will run three to seven times as fast as a standard 486 because it contains a smaller instruction set.

BUT HOW RELEVANT? With these capabilities, however, come the inevitable questions regarding the relevancy and practicality of the 80486. It's widely believed, for example, that the 486 will add the ability to simulate multiple 286 processors in protected mode, aiding in server-to-server network communications and running multiple servers on one PC. (The 386 can simulate multiple 8086 processors.) But realistically, who needs multiple 286s? Who needs a 60-MHz PC? Can a 60-MHz PC even be built?

Does any single PC user need a 60-MHz machine, let alone the N10 version? Sure, if you ask any CAD user, you'll get a quick thumbs up. And if you ask the staff of a desktop publishing or graphics art shop, struggling to keep on top of their bit-mapped image files, you'll find they want a 486; you can bet on it. The RISC version, too. But these are niche markets—not the general public of PC users—so the market for 486-based PCs will probably be small relative to the market for lesser processors.

It's a good thing, too, because 486-based PCs are going to be *very* expensive. They'll be expensive just because the processor itself will be. Intel is making a huge engineering investment in the 486, and the company will have to recoup its investment in the chip's price in order to balance the books.

But that's not all there is to it. The high cost of 486-based PCs will last for a long time because it won't be easy for the engineers that turn chips into PCs to build machines around the 486. Speed alone will make this expensive, and the cost of building PCs above 33 MHz is expected to go up geometrically. High-speed RAM that doesn't even exist yet will be needed, as will high-performance "glue" chips to hold the components of a PC together electronically.

Then there's the problem of EMI (electromagnetic interference). As processor speeds go up, EMI can cause cross-circuit interference and levels of radio signal interference that, if unchecked, can wreak havoc in office as well as home environments. EMI at these levels is difficult to control.

The 486 will undoubtedly bring us an expensive and interesting new generation of PCs. The new machines, when they arrive, will soon become the required machines for file server applications and some important niche markets. And you can bet they'll be the darlings of the PC power user set. But if you're like most users, you'll probably not need one for a long, long while.—**John Dickinson**

ry capabilities. Virtual memory allows the 386 to use data not currently stored in memory as though it were. It's only a matter of time before operating system designers press virtual memory into service.

INSTANT WINNER The 386 was an instant winner for a couple of good reasons. One was speed. The chip was born at 16 MHz, with 20 and 25 MHz in the queue and a clear plan to get to 33 MHz. Another of its winning ways is that it was designed with OS/2 as well as DOS 2 in mind. Other than backward compatibility with the 8086, the 80286 was designed without much regard for the software that would be written for it. The 386 design, conversely, came about with considerable input from Microsoft and other major developers.

The 386 was also designed as a rejoinder to the popularity of Motorola's 68000 line of microprocessors. Intel engineers had gotten tired of hearing about the 68000's flat address space (with which a program can directly address data anywhere in memory) and the limitations of the 286's segmented architecture.

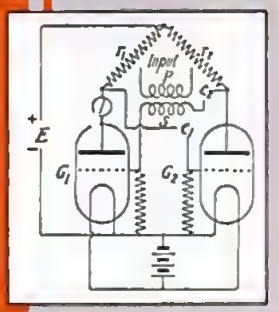
Another Kind of Memory

For many of us, it seems like only yesterday that the IBM PC's ROM-based operating system, 16K RAM, and cassette storage were the accepted route to personal computing. For others, it's memories of 80-column punched cards and long, long lines at the batch processor. No matter when you entered the fast-moving world of information processing, chances are you'll remember at least a few items in this collection of historical milestones.

1890 **Hollerith card**
1890

1900

1910 **Flip-flop circuit**
1919



1920 **IBM's 80-column punched card**
1928

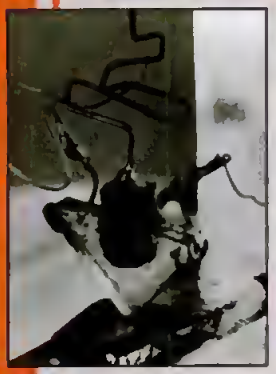
Demonstration of color televisIon
June 1929

1930

Information and pictures supplied by The Computer Museum, Boston, Massachusetts

1940 **ENIAC demonstrated at Univarsity of Pennsylvania**
1946

First succesaful point-contact transistor
December 1947



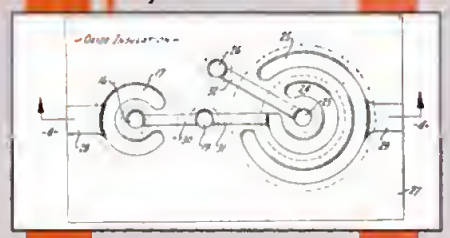
1950 **UNIVAC I, first working computer**
1951

IBM 701, first production model IBM computer
December 1952

First color TV commercial aired (with 16 sponsors)
June 1951

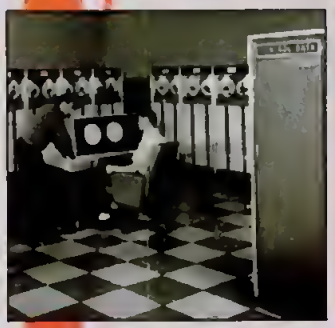
First nationwide color telecast (Tournament of Roses Parade)
January 1954

Robert N. Noyce patents integrated circuit
July 1959



1960 **IBM Selectric typewriter**
July 1961

CDC 6600, first supercomputer
1963



Touch-tone phones
November 1963

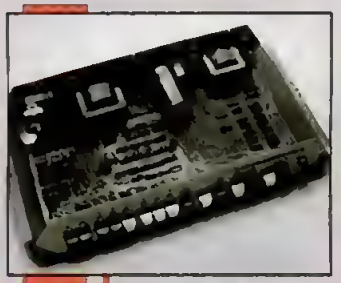
IBM's System 360
April 1964

First BASIC program runs at Dartmouth College
May 1964

First 256-bit RAM chip
1968

First Sony Trinitron TV sold in U.S.A.
1969

First manned moon landing
July 1969



1970 **Kenbak PC, first personal computer**
1971

Intel 4004, first microprocessor
November 1971

Bowmar Brain, first pocket calculator
December 1971

First Atari video games
1972

HP-35, first scientific pocket calculator
January 1972

Xerox Alto, first workstation with a mouse
1972

Wang word-processing system
1972

Intel 8080 and Zilog Z80 microprocessors
1974

CP/M operating system
Summer 1974

Bill Gates, age 19, forms Microsoft with Paul Allen
1974

MITS Altair featured on cover of *Popular Electronics*
January 1975

Apple I board announced
April 1976

Last K&E slide rule produced
July 1976

Apple II
June 1977

HP-01, first calculator watch
1977

Radio Shack's TRS-80 computer
August 1977

DEC VAX 780
1978

Speak and Spell (child's electronic learning aid)
1978

CompuServe founded
Spring 1979

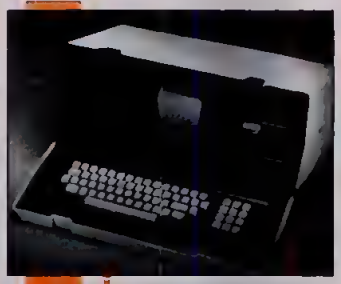
***Visicalc*, first spreadsheet**
May 1979

Sony Walkman
1979

1980

IBM Displaywriter System
June 1980

Hayes SmartModem
Summer 1981



Osborne I, first portable computer
April 1981

IBM PC
August 1981

Lotus 1-2-3
1982

Columbia, first clone of IBM PC
June 1982

First compact disk player
1983

First wristwatch computer, from Seiko
1983

IBM PC-XT
February 1983

IBM PC*jr*
October 1983

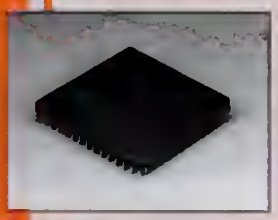
Apple Macintosh
January 1984

HP LaserJet
March 1984

IBM PC AT (6 MHz)
August 1984

IBM PC AT (8 MHz)
April 1986

80386 chip, first used in Compaq Deskpro
September 1986



IBM PS/2
April 1987

Compaq Deskpro 386/20
September 1987

Compaq Deskpro 386/25
June 1988

Compaq Deskpro 386S, first PC to use 80386SX chip
June 1988

1990

Segments actually make it easier to write some kinds of programs, such as multiuser operating systems. But the 64K segment size of the 286 was a woeful anachronism. While the 386 also has segments, these can be just as big as you like—a clear case of having your cake and eating it, too.

Of course, it's taken time for the operating systems vendors to harness the 386's inherent power. We reviewed five multitasking operating environments for the 386 in our February 28, 1989, issue and found them to be at various points along the path to nirvana. OS/2-386 is due out at the end of this year, and it will materially change the direction of software development on the desktop—far more than OS/2 has done to date.

How safe is it to buy a 386 machine? What of the compatibility issues, the memory architecture, the speed ratings, the chances for obsolescence? These are all worthwhile concerns, but from a compatibility standpoint, the 386 market has turned out to be somewhat of a yawner. Writing a BIOS has metamorphosed from black art to science, even though the number of practitioners remains small. Likewise, only a small handful of companies build the logic chips that govern the timing and operation of the motherboard. The result? Fairly strict adherence to the conventions first set forth in the PC AT. In fact, virtually all the machines reviewed here are more compatible than the early 12-MHz 286 machines.

PLENTY ROOM TO GROW Even with all this conformity, the manufacturers have found plenty of room for innovation and differentiation. Memory architectures, caches, disk controllers, and expansion schemes together ensure ample freedom of expression. While the low-end machines economize by offering no cache memory, the innovators are always angling for the hottest performance with new architectures. Some use ultrafast static RAM. Others use fancy prefetch devices, such as Intel's 82385 cache controller chip. Still others come up with proprietary memory control and caching hardware.

All these measures have a direct effect on performance; fortunately, they do not affect compatibility. But the design decisions a manufacturer makes do affect your purchases. A 386 using industry-standard SIMMs (single in-line memory modules) will be much cheaper to upgrade than one that uses the manufacturer's proprietary expansion boards or daughtercards. By the same token, a proprietary disk interface like Compaq's will cost you more if you decide to add or upgrade a hard disk.

The single most important reason to avoid 286 machines is that they have no future. Intel might have built a multitiered product line in which the 286 had an ongoing, vital role, but the company didn't. The 286 licensees are reduced to making the chip a little faster and a little cheaper, both of which will ensure it a place in low-end computing for the foreseeable future. But OS/2 is the first and last program written for the 286. Once OS/2-386 is introduced, all software development for the 286 will effectively have ceased.

We are sure that the 386 is the only intelligent choice for corporate computing.

So if you want to buy a cheap machine to run DOS today and don't give a hoot about what you'll want tomorrow, fine. Buy a 286 machine, especially if you are going to run it at 10 or 12 MHz. But don't waste your words trying to convince us that the 286 has a bright and glorious future or, worse, that it's a good investment. We've heard all the arguments and are only more sure than ever that the 386 is the only intelligent choice for corporate computing and that even the 486 won't soon unseat it. Will *PC Magazine* enthuse over the 486? Doubtless. But will the 486 have any significant impact on mainstream desktop computing in the next 2 or 3 years? Doubtful.

This issue, however, isn't about the 286 or the 486; it's a celebration of the 386. Our surveys tell us that 16 percent of our nearly 750,000 primary readers are using 386 machines at work. More than 8 percent are using 386s at home. Major companies have already decreed that no more 286 machines will be purchased. In our capital budgeting for *PC Magazine*, we've rejected all requests for 286 machines, except laptops.

That's a trend. That's the future staring you right in the face. We could have reflected the status quo and done a knockout issue on the infinite varieties of 286 machines on the market. Indeed, we've already compared and will look again at 16- and 20-MHz 286 boxes. We've got to be useful, and as long as people are wasting their money on such machines, they might as well get the most for it.

HOW MANY MACHINES? Meanwhile, the 386 market is far larger than you might have suspected. As you know from the cover of this issue, our tireless editors found 104 computers from 58 companies and subjected them to the usual rigorous battery of tests in PC Labs. Along the way we eliminated vendors who are original equipment manufacturers (OEMs) only or who sell only to value-added resellers (VARs).

A number of the companies we contacted (Austin and Data General among them) chose not to participate. A few, such as Kaypro, Maxar, and Unisys, agreed to participate but somehow managed not to ship us a machine within the 2-month window we had allotted. Unix-only machines such as those from Sun Microsystems (which run DOS within a Unix environment) are not included. And one notable company, Epson, does not yet offer a 386 computer. We're confident, now that the dust has settled, that virtually every machine that might pique your interest is represented here.

We categorized the machines according to your buying habits, with a degree of common sense in the synergy between speed and configuration. Each company was asked to submit a desktop machine in each of three speeds: 16, 20, and 25 MHz.

ADVERTISEMENT

New UL 1449 Guide to Surge Protection Provides First Objective Standards

UL 1449: The New Watchdog

Until recently, there was no standard to go by in selecting a surge protector. Consumers had to make choices based on little-understood technical specifications that had nothing to do with the performance of a surge protector.

Then, in 1988, the famed Underwriters Laboratories, Inc. (UL) conducted independent tests of leading surge protectors and developed a new standard called UL 1449. The New UL 1449 Standard objectively measures the amount of voltage that can pass through a surge protector after clamping has occurred.

Power Surges Are Common: Earlier studies by the Institute of Electrical and Electronics Engineers (IEEE) have shown that the average office or household receives approximately 100 power surges or "spikes" each month, many as high as 1,000 volts.

Such surges occur whenever power output is "dirty," or not constant. Common sources of power surges in the AC power supply result from nearby lightning strikes, utility companies changing power loads, on-off switching of inductive motors and self-switching power supplies such as air conditioners, refrigerators and dishwashers. If your electronic equipment remains unprotected, these surges can cause irreparable damage to expensive electronics such as computers, TV's, VCR's, stereos and FAX machines. In computers, they can also cause disruption or total loss of valuable data.

Surge protectors act by "clamping" the moment a surge occurs, thereby controlling the amount of voltage that will pass through to your expensive systems or appliances.

UL 1449 and You: Choosing the Right Surge Protector: UL 1449 is a mandatory test for all surge protector manufacturers desiring the UL 1449 listing. A UL 1449 rating of 400 Volts Peak or less assures consumers that the final voltage going through their equipment is at a safe, clean level. Therefore, a surge protector with a UL 1449 rating of 400 Volts Peak offers superior protection to that of another surge protector with a UL 1449 rating of 500 Volts Peak or more.

Protection Features to Consider When Buying Or Specifying Surge Protectors:

- UL 1449 "Most Protection: Rating of no more than 400 Volts Peak."
- Hot to Neutral, Hot to Ground and Neutral to Ground Protection (which protects all incoming lines to your equipment).
- EMI/RFI Filtering—for protection against many electrical and radio frequency interferences.
- Telephone/FAX/Modem Protection—for protection of today's highly sophisticated electronic equipment which requires use of a standard telephone line.
- Manufacturer's Warranty.
- UL, UL 1449 & CSA Listed.
- UL 497A Listed for Protectors of Communication Circuits.

Personal Features to Consider:

- Power cord—for easy access, installation and comfort.
- Remote Switch—for convenient desktop ON/OFF switching.
- Manual ON/OFF switch—for easy control of up to six individual peripheral devices such as computer, printer, copier, calculator, stereo and FAX machines.
- Positive Operation LED (indicator) lights—for seeing at a glance that surge protection is operating at a safe, clean level.
- Phone/FAX Protection—to protect against equipment breakdown and business downtime.

All Curtis Surge Protectors meet the "Most Protection" rating of 400 Volts Peak or less. The Curtis Command Center Plus, a surge protector that controls and protects up to five electronic components received a UL 1449 rating of 330 Volts Peak, the best rating available.

Curtis products are available at computer, retail and office products stores nationally and in Canada. For further information on surge protectors and Curtis products, send for a FREE BROCHURE: "Surge protection and the New UL 1449 Standard." Write Curtis Manufacturing Company, Inc., 30 Fitzgerald Drive, Jaffrey, NH, 03452 or call 603-532-4123, EXT. 149, without obligation.

MOST PROTECTION												LEAST PROTECTION	
330	400	500	600	800	1000	1200	1500	2000	2500	3000	4000	5000	6000	VOLTS PEAK

Underwriters Laboratories has developed this chart to show the maximum voltage that can pass through a surge suppressor after clamping has occurred.

All Curtis Surge Protectors meet the "Most Protection" rating of 400 Volts Peak or less.

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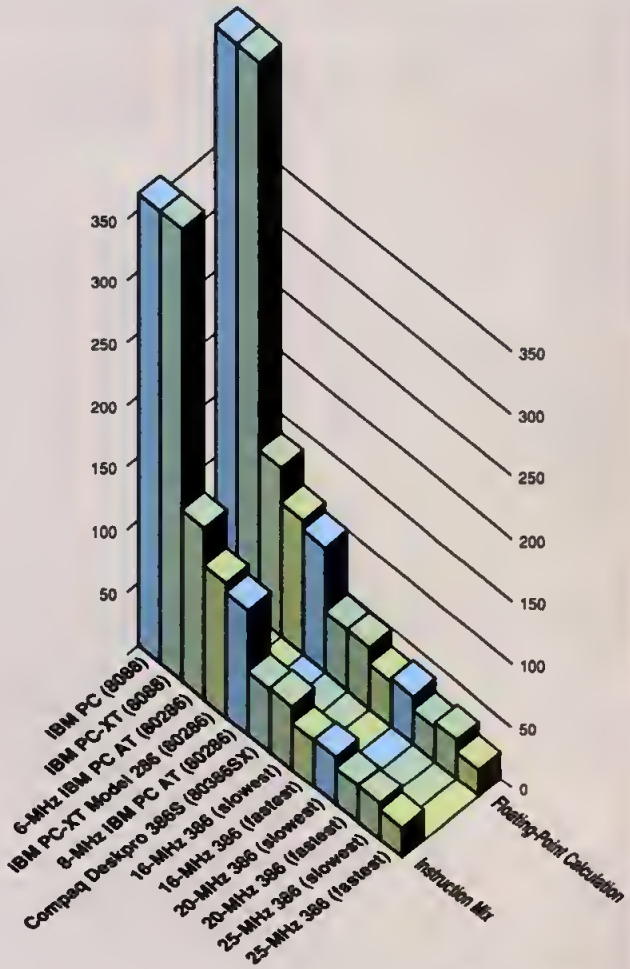
Benchmark Tests: PCs from Past to Present

The trip down processor lane doesn't often lead one to nostalgic reveries. In the olden days, we waited an exasperating 159.29 seconds for the original PC to run through our Floating-Point Calculation benchmark test; in that time you could call the local deli for a take-out lunch. Nowadays the fastest 25-MHz 386 we've gotten our hands on runs the floating-point test in about 8 seconds, and in that time you'd be hard-pressed to do more than pick up the phone and dial. We are on the eve of the emergence of 33-MHz 386s, however, and soon even dialing the phone will be too ambitious a project to undertake while you run PC Labs' benchmark test. How long before you'll have the result in the time it takes you to press Enter? That could be sooner than you think, judging from the momentum of 8 years of processor evolution.



These charts show the speeds of selected machines tested for previous *PC Magazine* issues, along with the performance of 80386-based machines reviewed in the present issue.

The **Instruction Mix** benchmark test measures the time it takes to execute a selected series of processor-intensive tasks. The test program uses the instruction code specific to the processor of the computer tested (8088, 80286, or 80386). These instructions are a subset of the total processor instruction set.

The **Floating-Point Calculation** benchmark test measures processor speed by looping through a series of floating-point calculations, including multiplication, division, exponentiation, and logarithmic and trigonometric functions. The benchmark program uses the floating-point library included with Microsoft C Compiler 4.0.

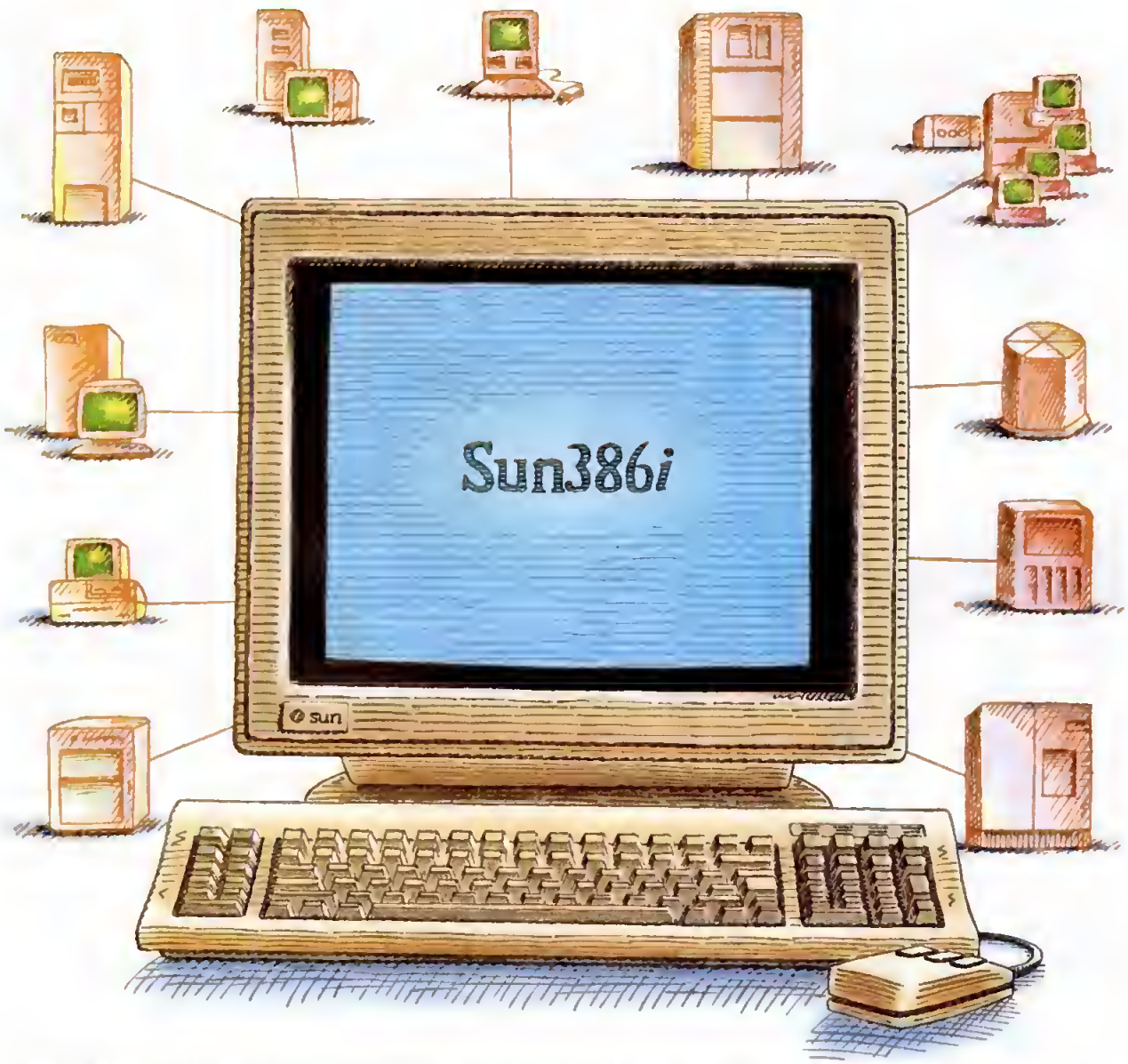
Performance Times
(Times given in seconds)

Relative Times
(8-MHz IBM PC AT = 100)

	Instruction Mix	Floating-Point Calculation
IBM PC (8088)	32.57	159.29
IBM PC-XT (8088)	32.57	159.29
6-MHz IBM PC AT (80286)	12.25	47.86
IBM PC-XT Model 286 (80286)	9.61	38.06
8-MHz IBM PC AT (80286)	8.96	35.60
Compaq Deskpro 386S (80386SX)	4.56	17.36
16-MHz 386 (slowest machine tested)	4.69	17.35
16-MHz 386 (fastest machine tested)	3.48	12.65
20-MHz 386 (slowest machine tested)	3.57	13.71
20-MHz 386 (fastest machine tested)	2.76	10.10
25-MHz 386 (slowest machine tested)	2.69	11.61
25-MHz 386 (fastest machine tested)	2.20	8.02

OS/2 promises you the moon.

But it'll ne
everything u



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CIRCLE 366 ON READER SERVICE CARD

We weren't looking for any 33-MHz reality stretchers. We asked that the 16-MHz machines be outfitted with 2MB of RAM and a 40- to 70MB hard disk. We requested that the 20-MHz machines come with 2MB of RAM but with a 60- to 120MB hard disk. The 25-MHz machines were to have 4MB RAM and hard disks with capacities of 100MB or more. The reviews and the features table are presented alphabetically by company (within each review, the machines are discussed in order of clock speed). Benchmark tests are grouped by rated clock speed.

We didn't cover 386 portables in this issue because of the all-but-overwhelming number of desktop machines. You can count on coverage of the 386 portables in future issues. The 386SX got off to a slow, uncertain start because Intel had priced the chip too high. That's reflected in the small number of SX machines available for review in this issue (see the sidebar "Jump Start for the 386SX"). We have every reason to believe, however, that the future is bright for the SX.

This issue, overall, contains an enormous amount of information about the fastest-growing segment of the market. We couldn't sort it in all the ways that might be useful to you, but you can sift through the feature table, benchmark tests, reviews, sidebars, and accompanying articles to achieve your objectives. There's a lot to consider—such factors as speed, memory architecture, desktop footprint versus tower design, the number of expansion slots, type of vendor, price, and so on. Don't miss John Dickinson's sidebar on the 486: what it offers and why it won't obsolete 386 machines. We also test a few new disk-controller technologies from VIPC and SPT. The differences are startling.

Finally, there are the Editor's Choices. In each category we've selected machines that we would (and will!) spend our own money on. You may not agree with our choices; that's your privilege. Use them as a point of departure, and then consider all the variables upon which you'll base the computing decisions that will take you into the 1990s.—**Bill Machrone**

Bill Machrone is editor-in-chief and publisher of PC Magazine.

ACER TECHNOLOGIES CORP.

ACER 1100/16
ACER 1100/20
ACER 1100/25

Not everyone can afford to pay a computer consultant high hourly fees to make system recommendations. Here's a tip: many consultants and value-added resellers often recommend Acer Technologies computers. The Acer 16-, 20-, and 25-MHz 386s are neither the least expensive nor the fastest in their respective classes. But their high level of compatibility, combined with Acer's wide distribution network and strong service policy, make them highly reliable commodities.

All units in the Acer 386 line are desktop models: the 1100/16 is base-priced at $3,195; the 1100/20, $3,945; and the flagship 1100/25, $6,295. The minimum configuration for each includes 2MB of RAM, two serial ports and one parallel port, a 1.2MB 5¼-inch floppy disk drive, and a floppy/hard disk controller. Monitor, video card, and hard disk are not included.

Each Acer machine uses shadow RAM technology to quicken BIOS and video performance, and all three set the system bus speed for expansion cards at a conservative 8 MHz. The motherboards are Acer-designed and manufactured; the chips are Award BIOS.

The Acer machines' exteriors are similar, including a front-panel reset switch and three exposed half-height bays. The main difference is that in the Acer 1100/25, the I/O connectors are to the left of the slot openings, as these ports are built into the motherboard.

The Acer 386 power supplies have five device connectors and a switched outlet. The 16- and 20-MHz models use a 200-watt Astec power supply; the 25-MHz version comes with a more generous 230-watt unit from Delta. Each machine can hold five half-height storage devices, with three exposed for removable media.

The units' exteriors are fairly similar, including a reset switch on the front. The only difference among them is that the serial and parallel port connectors are positioned to the left of the expansion slot openings on the 25-MHz machine; these ports are built directly into the motherboard.

All the systems come with a fine, Acer-made Enhanced-style keyboard: it has a light, clicky feel and an 8-foot cord. DOS and GW-BASIC are also standard with these machines. Other bonuses include *Microsoft Windows*, an Acer-manufactured serial-port mouse, and an extended-memory-manager program.

ACER 1100/16 The 16-MHz Acer 1100/16 is a two-wait-state machine with 1:1 memory interleaving. Going beyond the $3,195 base price, for $4,600 you can get the unit configured with Acer's monochrome card and analog monitor, as well as a 70MB MiniScribe hard disk. Substituting Acer's VGA monitor ups the price to $5,305. Our test configuration included a Western Digital ST-506 drive controller, VGA, 70MB hard disk, and 4MB of RAM for a list price of $6,230.

This 16-MHz unit (which can also run at 4.77, 6, or 8 MHz) uses 100-nanosecond DRAM TTL memory chips. You can put up to 4MB of 32-bit memory on the motherboard and up to 16MB more on a proprietary memory expansion card that you can install in the single 32-bit expansion slot. Of course, current versions of DOS and OS/2 support only up to 16MB of RAM.

Besides the 32-bit slot, you get one 8-bit slot and six 16-bit slots. You don't get any memory caching on this machine (or on its 20-MHz sibling), but the 1:1 interleaving helped it score well on PC Labs' benchmark tests.

Paradise.
It's also the only company that sells more PC graphics cards and chips than IBM.**

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CIRCLE 359 ON READER SERVICE CARD

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Jennifer Zaino is a staff editor of *PC Magazine*.

ACER 1100/20 If you like the 1100/16 but want 20-MHz performance, the Acer 1100/20 offers the same options as the 16-MHz machine. Our test machine came with 4MB RAM, a Micropolis 159MB hard drive, and an 80387 coprocessor.

The 1100/20 has the same Acer-made motherboard as the 16-MHz unit, the same available slots, and the same memory configuration options. Where the 1100/20 surpasses its 16-MHz brother is in its speedier processor (of course), its use of 80-nanosecond memory chips, and its ability to run at zero wait states. Even without cache memory, the 20-MHz machine (which can also be set to run at 4.77, 6, and 8 MHz) tested in the upper half of the 20-MHz group. The DTC ESDI hard disk controller and RLL-coded hard disk helped it perform especially well on the large-record DOS File Access benchmark test.

ACER 1100/25 The 1100/25 is a competitively priced system: the test configuration, which included 4MB of RAM, a 159MB hard disk, and a VGA monitor, sells for $10,017. If you're content with only 2MB of RAM, a 70MB hard disk and a VGA color monitor, the price drops to $8,955; substituting a monochrome monitor in the same configuration lowers the price even further, to $8,250.

Although the motherboard on the top-of-the-line 1100/25 is also Acer-made, it is not identical to the ones found on its slower siblings. Besides the built-in parallel and serial ports, this board houses 32K of cache memory in the form of an Intel 82385 cache controller chip. The 25-MHz processor can be throttled down to 6 or 8 MHz; you can also keep the machine running at zero wait states.

This motherboard will accept up to 8MB of 80-ns. 32-bit RAM in SIMM packs. Each of the two 32-bit expansion slots can take a 16MB memory expansion card, bringing the total possible system memory to 40MB. While there are nine slots in all, including six 16-bit and one 8-bit slots, only eight are available for use

PC MAGAZINE FACT FILE

Acer Technologies Corp.
4010 Charcot Ave.
San Jose, CA 95131
(408) 922-0333
(800) 782-1155

Acer t100/t6
List Price: With 2MB RAM, 1.2MB 5¼-inch floppy disk drive, DOS 3.3, $3,195; with 70MB hard disk, monochrome monitor, mouse, $4,600; with VGA monitor, $5,305; with 4MB RAM, $5,954. 2MB RAM upgrade, $649; 60MB tape backup, $995.
CIRCLE 603 ON READER SERVICE CARD

Acer 1100/20
List Price: With 2MB RAM, 1.2MB 5¼-inch floppy disk drive, DOS 3.3, $3,945; with 70MB hard disk, monochrome monitor, mouse, $5,350; with VGA monitor, $6,055; with 4MB RAM, 159MB hard disk, 80387-20 coprocessor, $8,382. 2MB RAM upgrade, $678; 60MB tape backup, $995.
CIRCLE 604 ON READER SERVICE CARD

Acer 1100/25
List Price: With 2MB RAM, 1.2MB 5¼-inch floppy disk drive, DOS 3.3, $6,295; with 70MB hard disk, monochrome monitor, mouse, $8,250; with VGA monitor, $8,955; with 4MB RAM, 159MB hard disk, $10,017. 2MB RAM upgrade, $762; 60MB tape backup, $995.
CIRCLE 605 ON READER SERVICE CARD

In Short: Often the consultant's choice, these solid computers performed well in their classes and have reasonable performance/price-increase ratios. Acers come with on-site service, but are also being sold by service-oriented dealers. Not the cheapest, but darned good.

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because of the placement of a 32-bit memory slot directly behind one of the 16-bit slots. That's not a problem: no one running DOS or OS/2 on this system will need the second 32-bit slot, at least for now.

Since Acer also uses a fully arbitrated bus on this machine, in the future it may be possible to install a second board with its own processor in the additional 32-bit slot.

The 1100/25 scored above the mean on all of the processor and memory speed tests. The same Micropolis 159MB hard disk and DTC ESDI controller combination that worked so well on the 20-MHz machine, however, was not as impressive in the 1100/25; the system lost out to other vendors' hotter drives in the DOS File Access benchmark tests.

Acer's standard 1-year parts-and-labor warranty means you get on-site service by TRW (one of the largest computer hardware repair services) for the first 4 months, and depot service either at TRW service sites or at Acer itself (and soon at more than 200 dealer and distributor sites) for the remaining 8 months. This strong support network, combined with quality performance and reliability, makes the Acer machines very good bets.—**Bruce Brown**

ADVANCED LOGIC RESEARCH INC.

ALR FLEXCACHE 20386DT
ALR FLEXCACHE 25386

Advanced Logic Research knows that everyone associates three initial letters with reliable business computers. The company simply wants you to stop thinking "IBM" and start thinking "ALR."

ALR's FlexCache 25386 has already established itself among the fastest and sturdiest computers you can buy—at a price much lower than the computers sold by the company that uses those other three initials. The FlexCache 25386 runs its processor at 25.3 MHz—a trivial amount higher than Intel's rated speed, and one reason that the benchmark test results look so impressive. But there's more than a slightly hyperthyroid clock crystal that makes the FlexCache stand out from much of the competition.

The ALR FlexCache 25386 is distinguished not only by its speed but by its ideal network-server design: the absence of reset buttons on the case and easy access to power-off switches help avoid accidental system shutdowns.

The FlexCache 25386 is one of the few computers explicitly designed more as a network server than as a personal computer. You won't find a reset switch anywhere on this machine's tower case. That means that you or your office mates won't be able to disrupt the whole office by accidentally bumping up against that switch while everyone else is accessing the network. You won't even find it easy to switch the machine off. ALR's case makes you open a knurled knob, lift up a door, and twist your hand in Houdini-like contortions before you can reach that big red switch.

LITTLE STRIPPING DOWN ALR, much like IBM but unlike many computer vendors, doesn't expect you to start with a stripped-down 25-MHz machine and only later add niceties like a hard disk and a video card when you discover that one floppy disk drive and a speaker aren't enough for serious computing.

When you pay $9,499 for the FlexCache 25386 in its base configuration, you get a quiet 150MB ESDI hard disk made by CDC and hooked up to a Western Digital controller. You also get a hefty 4MB RAM, a 1.2MB floppy disk drive, ALR's 16-bit VGA card based on the Paradise chip set, and a serial and parallel port. If you want DOS, your dealer will have to sell you a different computer.

ALR gives you a keyboard with an excellent responsive feel—but also with that infuriating half-size backspace inflicted on early AT buyers. A switch on the back lets you swap the locations of the Ctrl and CapsLock keys. A second switch turns the keyboard from a standard AT keyboard into an XT keyboard.

The company's tower case has heavy black vertical fins that make it look like one of Darth Vader's favorite pets. It has open bays for two 5¼-inch half-height devices and one 3½-inch drive. You can also install two full-height internal drives with no access to the front panel. Although this arrangement lets you install two floppy disk drives and a $1,890 150MB tape

PC MAGAZINE FACT FILE

Advanced Logic Research Inc.
9401 Jeronimo Rd.
Irvine, CA 92718
(714) 581-6770
(800) 444-4257

ALR FlexCache 20386DT
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, $2,695; with 66MB hard disk, monochrome monitor, DOS 3.3, $4,319; with VGA monitor, $5,013; with 2MB RAM, 120MB hard disk, $6,884. 1MB RAM upgrade, $495; 40MB tape backup, $990.

CIRCLE 408 ON READER SERVICE CARD

ALR FlexCache 25386
List Price: With 4MB RAM, 150MB hard disk, 1.2MB 5¼-inch floppy disk drive, VGA card, $9,499; with DOS 3.3, VGA monitor, $10,219; with 1.2MB 5¼-inch and 1.44MB 3½-inch floppy disk drives, $10,444. 1MB RAM upgrade, $495; 150MB tape backup, $1,890.

CIRCLE 408 ON READER SERVICE CARD

In Short: ALR's 20- and 25-MHz systems offer sturdiness and speed—plus competitive prices. The 20-MHz model includes such features as 32K of cache RAM and a 120MB ESDI drive to help maintain speed. The 25-MHz model, designed more as a network server than as a personal computer, runs its processor at 25.3 MHz—slightly higher than Intel's rated speed, and one reason that the benchmarks look so impressive.

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CIRCLE 362 ON READER SERVICE CARD

drive, it still seems needlessly restrictive. Another open 5¼-inch bay would let you add a CD-ROM drive or optical drive. And the cabinet seems to have plenty of space for adding more 3½-inch drives, but there's no way to access that space. Even if you had drive bays for other devices, the 200-watt Astec power supply comes with only four connectors.

ALR's homegrown motherboard holds one bank of 60-nanosecond 32-bit RAM, currently amounting to 1MB in the form of 256-kilobit chips; future models will have 4MB using 1-megabit chips. One of the expansion slots holds a 32-bit memory card with 3MB of 80-ns. RAM; a future model will hold 4- to 12MB. Of the remaining slots, six are 16-bit and one, occupied by a combination serial/parallel/floppy disk drive controller card, is 8-bit. The 25386 uses 64K of cache memory controlled by ALR's proprietary emulation of the Intel 82385 cache controller. You can install a Weitek coprocessor in addition to an 80387.

SMOOTH OPERATION PC Labs tested the $9,499 base configuration of the FlexCache 25386, with the addition of a $225 1.44MB floppy disk drive and a Mitsubishi VGA monitor that you can't buy from ALR. Once the keyboard switch was correctly set (it arrived set for the XT option), everything about the machine worked smoothly, quietly, and extremely quickly.

In contrast with the FlexCache 25386, the 20-MHz FlexCache 20386DT desktop machine seems almost ho-hum—although a few months ago any 20-MHz machine would have made most users gasp. The test results place it high among the faster 20-MHz machines. The stripped-down $2,695 base configuration of the 20-MHz model comes with 1MB of 80-ns. RAM, a 1.2MB floppy disk drive, a serial and a parallel port, and the same excellent keyboard as the 25-MHz machine. PC Labs tested a $6,884 model with 2MB of RAM (all on the motherboard), a 120MB ESDI drive, ALR's 16-bit VGA card, and a Mitsubishi VGA monitor.

The 20-MHz model uses the Intel cache controller and 32K of cache RAM; it accepts 8MB of RAM in the two proprietary slots that combine to hold the optional 32-bit memory card. Of the remaining slots, two are 8-bit, four 16-bit. You can install five half-height devices, but you get front-panel access to only two.

By the time you read this, ALR will ship all its machines with a copy of the *Super PC-Kwik* disk cache. Combine that with ALR's swift and silent CDC disk drives, and you have a system that's network-safe at any speed.

—Edward Mendelson

ALTEC TECHNOLOGY CORP.

ALTEC ZIP-386/16
ALTEC ZIP-386/20

When asked why anyone should buy its 386-based PCs, the folks at Altec answer, "Because we use brand-name parts." A look inside the company's ZIP-386 machines proves the point: components by such well-known companies as Micronics, Seagate, and Western Digital fill Altec's boxes.

Budget considerations may also lead you to the Los Angeles–based clone vendor. Although not the lowest we've seen, Altec's prices are reasonable enough to satisfy all but the most bargain-hungry shoppers. For a ZIP-386/16 base system with 1MB RAM, one floppy disk drive, a parallel port, a serial port, and a keyboard, you'll spend $1,595. For a similarly configured ZIP-386/20, you'll pay $250 more.

Despite their names, Altec's 386s didn't exactly zip through our benchmark tests. Then again, they didn't crawl. The ZIP-386/20 performed slightly better in comparison with the other 20-MHz machines in our roundup than the ZIP-386/16 did against its peers.

STRATEGIC DECISIONS At the core of Altec's brand-name strategy lie mother- and daughterboards made by Micronics. The AT-size motherboard contains the 386 chip and an 80287 coprocessor slot (an adapter is required for the 80387), but no memory. You'll have to give up the machine's only 32-bit slot for the Micronics memory board, which uses 80-nanosecond static-column TTL chips.

Design connoisseurs may snicker at the board's chips—half are soldered, half are slotted—but they get the job done. If you want more than the standard 1MB RAM, you can add an additional megabyte to the board (at press time Altec was charging approximately $400 per megabyte) or buy piggyback boards with 2-, 4-, or 8MB of memory. A $1,400 replacement motherboard with 4MB of RAM is also available.

System speed is helped in that the computers' video and system BIOS ROM are loaded into 384K of shadow RAM. Both machines operate only with zero wait states, with a steady 8-MHz bus for the ZIP-386/16 and a fixed 10-MHz bus for the ZIP-386/20. With software, you can slow the clock speed of either machine to 6 or 8 MHz.

Both ZIP-386s have eight expansion slots: two 8-bit, five 16-bit, and the occu-

The Altec ZIP-386/16 and ZIP-386/20 (in the tower case) operate with zero wait states. The bus speed is fixed at 8 MHz for the 386/16 and at 10 MHz for the 386/20, but their clock speeds can be adjusted to 6 or 8 MHz.

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*PC Magazine "Editor's Choice," 12/22/87
InfoWorld "Report Card," 6/27/88.
PC Week reader poll, 10/31/88.

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CIRCLE 138 ON READER SERVICE CARD

System requirements:
IBM PC, XT, AT, PS/2 and compatibles, with hard disk. At least 512K and MS-DOS 3.x.

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PC MAGAZINE FACT FILE

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(800) 255-9971

Altec ZIP-386/16
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, $1,595; with 60MB hard disk, monochrome monitor, DOS 3.3, $2,195; with VGA monitor, $2,795; with 2MB RAM, 43MB hard disk, 1.2MB 5¼-inch and 1.44MB 3½-inch floppy disk drives, $2,995. 1MB RAM upgrade, $495; 80MB hard disk, $595; 60MB tape backup, $445.

CIRCLE 414 ON READER SERVICE CARD

Altec ZIP-386/20
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, $1,845; with 60MB hard disk, monochrome monitor, DOS 3.3, $2,445; with VGA monitor, $3,045; with 2MB RAM, 65MB hard disk, 1.2MB 5¼-inch and 1.44MB 3½-inch floppy disk drives, $3,245. 1MB RAM upgrade, $495; 80MB hard disk, $595; 60MB tape backup, $445.

CIRCLE 415 ON READER SERVICE CARD

In Short: Altec Technology Corp. markets two ZIP-386s, a 16-MHz and a 20-MHz model. Although they aren't the fastest or the cheapest on the market, they are solid machines featuring brand-name parts. A good buy, they're clearly affordable.

pied 32-bit slot. And there are plenty of cutouts for D-connectors: five for 25-pin and three for 9-pin connectors.

The ZIP-386s have five half-height bays, three of which are open to the front. Getting to the other two is awkward because it requires emptying the front three bays.

MORE PROOF The $2,995 16-MHz desktop system we tested was further proof of the company's commitment to brand-name components. Besides the Seagate 43MB hard disk and the Western Digital ST-506 controller, you get Phoenix's 1988 BIOS, Video Seven's 8-bit VEGA VGA board and a NEC MultiSync II monitor. The 285-watt power supply with four connectors was made by D.V. Power Supply. Altec uses standard AA batteries, which are cheaper and easier to find but need to be replaced more frequently than do lithium batteries. The system also included 2MB RAM, two floppy disk drives (a 5¼-inch 1.2MB and a 3½-inch 1.44MB), and DOS 3.3.

The $3,245 20-MHz unit we tested shared much with its slower sibling, though it came in a tower case. Where it differed, the ZIP-386/20 still sported impressive labels: its 1988 BIOS was written by Award Software; the ST-506-type controller was from Data Technology; the Seagate hard disk was upped to 65MB; and Paradise supplied the 8-bit VGA card. Strangely enough, the D.V. power supply found in this unit was only 275 watts strong but had an additional two connectors.

Monterey International Corp.'s Enhanced-style 101-key keyboard, which comes standard with Altec's PCs, is quite comfortable. The Enter key is oversized, and the F and J keys have convenient raised bumps. Unfortunately, the backslash key is awkwardly placed below, rather than above, the home-row keys.

Altec offers a 30-day money-back guarantee—but it won't pay for the shipping and won't take back the monitor. Support is a staff of three technicians who can be reached by a toll-free number during Pacific Standard Time business hours.

Altec's ZIP-386s may not be the fastest—or the cheapest—386s on the block, but they'll give you a reasonably solid, reasonably priced, *reasonably* speedy ride.—**Mary Kathleen Flynn**

AMAX ENGINEERING CORP.

AMAX PC/386-16
AMAX PC/386-20
AMAX PC/386-25

Amax Engineering has manufactured motherboards and system units for other companies for several years, but it is now taking the mail-order route and selling machines under its own name. From the outside, it's hard to tell the three Amax 386 computers apart. The 16-, 20-, and 25-MHz machines look the same, from their desktop dimensions to the number and location of ports. Each uses the Maxi-Switch 101-key Enhanced-style keyboard (a reasonably responsive model with a positive keyboard click). The triple-vision effect was further enhanced by the identical Samsung VGA monitors shipped with the three test units.

Amax's 16-, 20-, and 25-MHz systems are remarkably alike, from their desktop dimensions to zero-wait-state operation. The Amax PC/386-25 differs most from its siblings in its use of an AMI, rather than a proprietary, motherboard.

Fortunately, the resemblance continues in terms of performance and price. Each machine runs with zero wait states (unalterable), automatically shadows BIOS and video ROM, and uses interleaved memory for greater speed. The systems racked up fine overall scores on our benchmark tests, falling in the midrange of their respective classes. And the prices are relatively low: the base 16-, 20-, and 25-MHz units—$1,935, $2,585, and $4,460, respectively—include 1MB of RAM, one parallel and two serial ports, a game port, a floppy/hard disk controller, and a 1.2MB floppy disk drive. You can choose between the equally capable Phoenix and Award BIOSs.

Inside each unit sits a 200-watt power supply with only four device connectors, although the case can accommodate five devices. Expansion slots are the same on all three machines, too—two 8-bit and five 16-bit, as well as one 32-bit proprietary slot occupied by a memory card containing

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CIRCLE 161 ON READER SERVICE CARD

PC MAGAZINE FACT FILE

Amax Engineering Corp.
47315 Mission Falls Ct.
Fremont, CA 94539
(415) 651-8886
(800) 888-AMAX

Amax PC/386-16
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, $1,935; with 40MB hard disk, monochrome monitor, DOS 3.3, $2,675; with VGA monitor, $3,275; with 2MB RAM, 80MB hard disk, $4,046. 1MB RAM upgrade, $495.
CIRCLE 419 ON READER SERVICE CARD

Amax PC/386-20
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, $2,585; with 40MB hard disk, monochrome monitor, DOS 3.3, $3,250; with VGA monitor, $3,850; with 2MB RAM, 150MB hard disk, $5,463.
CIRCLE 417 ON READER SERVICE CARD

Amax PC/386-25
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, $4,460; with 40MB hard disk, monochrome monitor, DOS 3.3, $5,035; with VGA monitor, $5,635; with 4MB RAM, 150MB hard disk, $8,238.
CIRCLE 418 ON READER SERVICE CARD

In Short: Amax makes solid, commodity-type computers. Other vendors sell Amax's 16-MHz and 20-MHz units under their names, but now Amax sells the computers under its own name as well. Come for the price, stay for the quality.

all the system RAM. The standard systems use 256-kilobit memory chips for a maximum of 4MB of RAM, but you can order 1-megabit chips to get up to 16MB of slotted memory.

AMAX PC/386-16 Although notably homogeneous in many respects, the machines do differ in some ways. For instance, while both the PC/386-16 and PC/386-20 use Amax's own motherboards, the PC/386-25 features a Micronics motherboard. Lest you wonder whether Amax lacked the faith to install its own motherboard in its top-of-the-line machine, be advised that the company never did manufacture 25-MHz boards.

The 16-MHz Amax can be set to run at 6, 8, or the full 16-MHz via software. This is less convenient than using keyboard toggles, but at least you can always put the speed setting command in a batch file.

The expansion-slot bus runs at a standard 8 MHz, although the increasing number of expansion cards that can take advantage of faster speeds makes this a somewhat conservative choice. Still, the 8-MHz bus speed is helpful since you can't slow the system down by changing wait states.

The unit's $1,935 base price is an eye-opener. Even the test configuration (with 2MB of RAM, a Seagate 80MB hard disk drive, a VGA monitor, and DOS) costs only $4,046. This model may not have killer speed, but think about this: for only a little more than you'd pay for a similarly equipped AT clone, you can have a true 32-bit 80386 system.

AMAX PC/386-20 The main difference between the Amax 16- and 20-MHz versions, besides the speed of the processor chip, is the cache memory found on the PC/386-20. An Austek cache controller chip on the memory board is in charge of 32K of 35-ns. cache memory.

There are other minor differences between the two machines. The expansion bus on the PC/386-20, for instance, is a straight 10 MHz, which is fine as long as you verify that the cards you want to add will run at this speed.

Our test unit with 2MB of 80-ns. RAM, a Maxtor 150MB hard disk drive, VGA card and monitor, and DOS came to $5,463. If you can spend about $1,500 more, this fully configured 20-MHz system works out to be even a better deal than the tested 16-MHz machine. You not only get a faster processor and cache memory, but also nearly double the hard disk storage space.

AMAX PC/386-25 Unlike the Amax motherboards found on the other PC/386s, the 25-MHz Micronics motherboard will take only an Intel 80387 or Weitek chip; there's no slot for any 80287 you might have hanging around.

The standard 25-MHz processor speed can be slowed to 8.3 and 12.5 MHz via software. You can set the expansion bus at either 8.3 or 12.5 MHz, a good compromise between old and new board speeds. Of course, until Amax emulates Zenith's way of running individual slots at different speeds, the presence of just one of the older and slower boards in your system means that everything will have to run in slow bus mode anyway.

Unlike its siblings, the 25-MHz Amax unit garners an FCC A rating for office use only. That's not a great tragedy, though; the price of a fully configured system, while very competitive with other companies' 25-MHz machines, is probably more than what most home office users can afford to spend. The test machine, with 4MB RAM, an Intel 82385 cache memory controller, 32K of 35-ns. cache memory, the Maxtor 150MB hard disk, VGA card and monitor, and DOS, came to $8,238.

While that price is one of the lowest we've seen for a fully configured 25-MHz 386, you should consider laying down that kind of money only if your activities demand an 80387 coprocessor and the increased RAM and processor speed.

While not particularly outstanding for any one trait, the Amax machines have two important things in their favor: their prices are on the low side, and the company has obviously proved its trustworthiness to the vendors who buy from it. If you're going to buy by mail, these factors translate into solid value.—**Bruce Brown**

AMDEK CORP.
AMDEK SYSTEM/386e

Amdek is best known for its monitors, but its System/386e is an immediate attention-getter as well, mainly because of its looks. It's not radically different from the AT look-alike clones, but the slightly slanting front and dark-tinted drive access cover make enough of a statement to be noticed.

The System/386e has a few other features that differentiate it from the norm, but for the most part, it's a straightforward 16-MHz 386 PC, available through dealers for a reasonable base price of $3,499. The price includes 1MB RAM, one 1.2MB floppy disk drive, one parallel and two serial ports, and DOS.

A WYSE DESIGN The 386e uses a motherboard manufactured by Amdek's parent company, Wyse Technology. The

The slightly slanting front and dark tinted drive access cover help the Amdek System/386e stand out. The motherboard is an amalgamation of a horizontal expansion bus board, a horizontally mounted controller, and cards that hold the processor, ROM, and memory chips.

distinguishing features of the Wyse motherboard are its integrated components: a horizontal board on the bottom of the case serves as the expansion bus; behind it, but on the same plane, is a horizontally mounted Western Digital floppy/hard disk controller. Vertical expansion cards, also considered by Wyse and Amdek to be components of the motherboard, hold the processor, ROM, and memory chips.

The 386e has ten slots—three 8-bit and seven 16-bit—all of which run at a straight 8 MHz. The vertical CPU card and memory card sit in the two 16-bit slots on the far right. The memory card is connected to the CPU card via a top connector, giving the 32-bit 80386 processor direct access to the memory chips without having to go through the slower 16-bit expansion bus. The current 32-bit maximum memory on the card is a meek 6MB, although a 16MB card should be out by summer.

The keyboard has a responsive, clicky feel, which is fortunate because the use of a modular phone plug type of connector instead of the more usual round ¾-inch plug means that replacing the keyboard could be a problem. It is similar to the usual 101-key Enhanced-style keyboard except for an additional Select key. This key is used in combination with function keys to switch between 16- and 8-MHz operating speeds and to access Amdek's built-in Help system.

Amdek's on-line Help system assists you in using Amdek's customized version of MS-DOS 3.3. The company has also altered the Phoenix ROM BIOS, adding such enhancements as DOS-compatible support for hard disk drives larger than 32MB.

THE TEST MACHINE The tested machine, with 2MB of RAM, an 8-bit VGA card, and an Amdek VGA monitor, is available at a list price of $6,034. That price includes the only hard disk drive Amdek supplies, a 43MB 28-millisecond Seagate ST-251-1. Emphasizing its dealer sales orientation, Amdek looks to dealers to install larger hard disk drives to customers who want them. For the same reason, Amdek doesn't sell math coprocessor chips, although the 386e has sockets for both an 80287 and an 80387.

At 16 MHz, the 386e runs with zero wait states, using 100-nanosecond static-column DRAM chips. Memory is interleaved, but there is no cache or shadow RAM. The design works well, however: the 386e scored above average for 16-MHz 386-based machines on all memory and processor benchmark tests.

The Amdek is interesting mainly because of its mother/memory board arrangement, nonstandard keyboard, and case front. Just as important, you get good performance and the security of buying a system from an established computer equipment company. As far as price and performance go, the 386e has the right ingredients.—**Bruce Brown**

PC MAGAZINE FACT FILE

Amdek System/386e
Amdek Corp.
3471 North First St.
San Jose, CA 95134
(408) 922-5700
(800) PCA-MDEK
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, DOS 3.3, $3,499; with 43MB hard disk, monochrome monitor, $4,557; with VGA monitor, $4,989; with 2MB RAM, $6,034. 1MB RAM upgrade, $695.
In Short: The Amdek System/386e is a good brand-name 16-MHz computer available only through dealers. It offers a pleasant if not astounding combination of quality components, good performance, and reasonable price.

CIRCLE 418 ON READER SERVICE CARD

AMERICAN MITAC CORP.
MITAC PARAGON 386C
MITAC PARAGON 386E

Do you own an endangered desk top, one of those pieces of office real estate threatened with extinction by encroaching papers, pens, and peripherals? If so, you might be interested in seeing just how much can be crammed into small-footprint computers like the American Mitac Paragon 386C and 386E.

These 386s are nearly identical except for their CPU clock speeds: the Mitac Paragon 386C (base-priced at $2,775) runs at 16 MHz, and the Mitac Paragon 386E ($4,050) clips along at 20 MHz. They use the same motherboard and components, the same case, the same keyboard, and even the same manual.

The case design shows some innovative and useful features. It has, for example, only two 5¼-inch drive bays (both of which are open to the outside through the case). In other computers, this might be viewed as a major limitation, but not here. That's because you also get a 3½-inch drive bay, placed on its side, next to the 5¼-inch bays; the setup lets you have both a 3½- and a 5¼-inch floppy disk drive, with room left over for a tape drive. An additional 3½-inch internal bay is perfect for holding one of the new small, low-power hard disks. The $5,638 16-MHz and $5,668 20-MHz review units came with drives from Conner Peripherals: a 100MB and a 40MB, respectively. The 145-watt power supply is strong enough to handle just about any expansion plans you might have for these machines.

DESIGNED WITH CARE The case is also ruggedly built; one side of the disk bays extends all the way to the back of the case to form a rigid divider that adds stability and strength. The keyboard cable plugs

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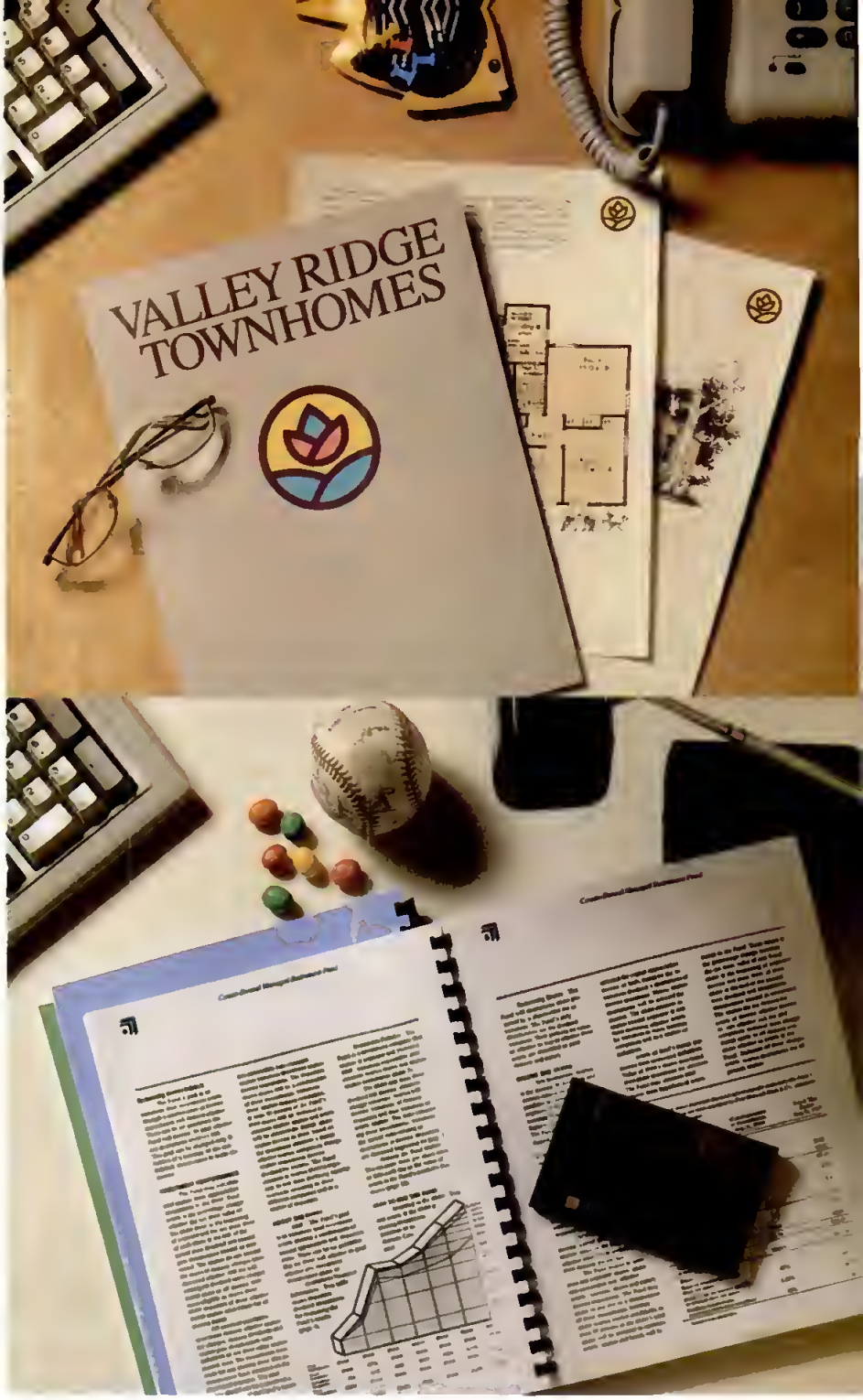

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CIRCLE 348 ON READER SERVICE CARD

The small-footprint case of the Mitac Paragon 386E, like its 16-MHz sibling, is ruggedly and thoughtfully built: In addition to two 5-inch and one 3½-inch bay, an internal bay can hold a small, low-power hard disk.

conveniently into the front of the case, where you also find a power switch and a reset button.

The company's own motherboard shows similar evidence of thoughtful design. It comes with two serial ports, a parallel port, and a floppy disk controller built right in. There are only five expansion slots (one 8-bit and four 16-bit), but the demands on these should be low given the features built into the motherboard.

American Mitac machines offer a Phoenix BIOS, with its useful setup programs.

The only problem with the motherboard is its memory limitations. It can accept either 256-kilobit or 1-megabit SIMM packaging. You can install either four or eight modules, which means you can have only 1MB, 2MB, 4MB, or 8MB 32-bit memory configurations. While 8MB of 32-bit memory may seem like enough for the moment, there is reason to believe that we may be looking at 12MB or 16MB as commonplace configurations in the not-so-distant future. Furthermore, you only get the performance benefits of interleaved memory in the 2MB and 8MB configurations.

American Mitac's own hard disk controller and 8-bit VGA board are admittedly not well known, and the test keyboard had a mushy Enhanced-style feel to it. The computers did offer a Phoenix BIOS, though, with its attractive and useful setup programs in ROM. The BIOS that came with the 20-MHz Mitac Paragon 386E offered an especially nice setup routine that gives access to disk drive and memory configuration, among other features.

The two models performed adequately enough in memory and processor tests, but without the benefit of a hardware cache, they tended to yield below-average figures. The disk test numbers were better: a bit above average for their respective classes. According to a representative from American Mitac, the latest version of the Conner drives performs even better.

I encountered only one real flaw in the machines. Both offered the ability to adjust the I/O bus speed for the expansion slots, and, although both worked at the promised 8- and 10-MHz speeds, they produced results opposite to the settings chosen during setup. In other words, a 10-MHz setting produced an 8-MHz result, and vice versa. The company said that this was a problem with early versions of the machines and has since been corrected.

While the systems have some limitations in terms of memory and slots, they should serve well for anyone with modest expansion plans. Some of the components are less familiar than are the industry standards, but good construction quality indicates that care and thought went into the design and assembly. And though the prices are not rock-bottom, they're still within the range of consideration, especially if you are fighting a losing battle to regain control of your desk top.

—Alfred Poor

PC MAGAZINE FACT FILE

American Mitac Corp.
410 E. Plumeria Dr.
San Jose, CA 95134
(800) 648-2287
(408) 432-1160

Mitac Paragon 386C
List Price: With 1MB RAM, 1.2MB 5¼-inch and 1.44MB 3½-inch floppy disk drives, DOS 3.3, $2,775; with 40MB hard disk, monochrome monitor, $3,664; with VGA monitor, $4,373; with 2MB RAM, 100MB hard disk, $5,638. 1MB RAM upgrade, $320.

CIRCLE 428 ON READER SERVICE CARD

Mitac Paragon 386E
List Price: With 1MB RAM, 1.2MB 5¼-inch and 1.44MB 3½-inch floppy disk drives, DOS 3.3, $4,050; with 40MB hard disk, monochrome monitor, $4,504; with VGA monitor, $5,213; with 2MB RAM, 100MB hard disk, $6,393. 1MB RAM upgrade, $320.

CIRCLE 429 ON READER SERVICE CARD

In Short: Sharing all features other than clock speeds, the Mitac Paragons are somewhat limited in expansion slots and memory capacity, but nevertheless merit consideration—especially if desk-top space is at a premium. The lack of a hardware cache hindered otherwise adequate benchmark test scores.

ARCHE TECHNOLOGIES INC.
ARCHE RIVAL 386

First impressions count, and Arche Technologies' Arche Rival 386 starts off ahead of many of the cookie-cutter AT-clone boxes. This small-footprint machine is attractively designed, with nicely rounded edges. Internal device expansion is limited to three half-height drives, but there are sufficient interface slots (eight in all) and enough memory capacity to satisfy most users' needs. Sharing your desktop with this computer isn't bad at all.

The Arche Rival 386's $3,895 base unit price includes 2MB of 80-nanosecond RAM, two parallel and two serial ports, a 1.2MB floppy disk drive, a floppy/hard disk controller, a monochrome adapter with 14-inch flat-screen, 1,000-line-resolution monochrome monitor, DOS 3.3, and GW-BASIC. The test machine also in-

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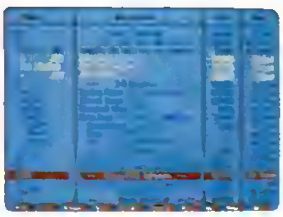

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CIRCLE 219 ON READER SERVICE CARD

With its small footprint and nicely rounded edges, the Arche Rival 386 breaks out of the AT-clone mold. The machine also departs from the norm by offering 20-MHz speed using a 16-MHz processor teamed with a 20-MHz crystal.

cluded a 1.44MB floppy disk drive, a 66MB RLL hard disk drive, and an EGA video adapter and display, for a list price of $5,569. While these prices may be higher than you'd pay for a mail-order machine, they compare well with national brands like AT&T, Compaq, IBM, Tandy, and Zenith.

PC MAGAZINE FACT FILE

Arche Rival 386
Arche Technologies Inc.
48881 Kato Rd.
Fremont, CA 94539
(800) 422-4674
(415) 683-6760
List Price: With 2MB RAM, 1.2MB 5¼-inch floppy disk drive, monochrome monitor, DOS 3.3, $3,895; with 66MB hard disk, $4,800; with EGA monitor, $5,400; with 1.2MB 5¼-inch and 1.44MB 3½-inch floppy disk drives, $5,569.
In Short: The Arche Rival 386 is a good-looking small-footprint model that squeezes 20-MHz performance out of a 16-MHz processor. It holds its own against other 20-MHz units in speed tests but doesn't have a price advantage, other than an exceptional 2-year warranty through Arche dealers.

CIRCLE 411 ON READER SERVICE CARD

PSEUDO SPEED? The Arche Rival 386 is sold as a 20-MHz unit, but a look inside reveals an Intel 80386-16 processor chip teamed with a 20-MHz crystal; the crystal controls the actual operating speed. Although this is not an uncommon practice, Intel recommends against pushing its chips faster than the rated speeds. Arche Technologies has taken care of the major cause for concern by installing fast (and expensive) 80-ns. memory chips.

The vendor assured us that it has never had a boosted 16-MHz chip fail, and we encountered no problems while running the machine at 20 MHz and zero wait states. Our benchmark tests showed that the system held its own with many of the true 20-MHz units, ranking near the middle of the spectrum.

Arche Technologies makes its own motherboards and uses a Phoenix ROM BIOS and a Chips and Technologies chip set. All memory is fitted onto a 32-bit memory expansion card, which can hold 8MB. A second 32-bit slot can accommodate another memory card with an 8MB capacity, bringing the system maximum to 16MB of 32-bit RAM, more than enough to run current OS/2 and DOS applications.

The expansion bus runs at 10 MHz, the high end of the usual standard for interface cards. With newer cards you should be OK, but it doesn't hurt to check if the add-in cards you need will run at that speed.

Four slots are available after adding in one floppy/hard disk controller, a single memory card, a video adapter, and a parallel/serial card. The 200-watt power supply isn't stingy, considering the three-drive limit of the system. There are four device connectors, though, so you could theoretically run an external device as well.

Arche offers eight hard disk drive options, ranging from 20- to 122MB. Since you won't be able to add a second internal hard disk drive, you should buy the highest-capacity drive you can afford the first time around.

The system deserves a better keyboard than the overly mushy Hi-Tek unit that came with the test machine. Hi-Tek keyboards usually have more response than the one we received, so the decidedly soft feeling was something of a surprise.

If you need lots of room for disks and tape drives, or worry that this isn't a *real* 20-MHz machine (although it sure acts that way), you'll probably want to look elsewhere. But if you want a brand-name computer that is sold and supported by local dealers, performs well, and doesn't hog desk-top space, the Arche Rival 386 fits the bill.—**Bruce Brown**

AST RESEARCH INC.
AST PREMIUM/386C

Following on the heels of the AST Premium/386 Model 300 is the company's latest 20-MHz unit, the Premium/386C. The "C" in the name stands for *cache*, and it represents the major performance enhancement made to the system: the addition of 64K of 25-nanosecond SRAM cache memory. (The Model 300, sans cache, is still available at a base price of $4,195.)

The $4,395 base system with no hard disk drive includes AST's own BIOS, the Intel 386 processor, a 1.2MB floppy disk drive, DOS 3.3, and GW-BASIC. A floppy disk controller plus one parallel port and two serial ports all reside on a motherboard made by AST itself. In addition, you get a 220-watt Triag power supply, plus easy access to three of the five half-height drive bays. All of this comes packaged

PC MAGAZINE FACT FILE

AST Premium/386C
AST Research Inc.
2121 Alton Ave.
Irvine, CA 92714
(714) 863-1333
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, DOS 3.3, $4,395; with 40MB hard disk, monochrome monitor, $6,085; with VGA monitor, $6,789; with 2MB RAM, 90MB hard disk, $6,995. 1MB RAM upgrade, $999; 150MB hard disk, $2,995; 40MB tape backup, $695.
In Short: Cache memory is the chief improvement found on AST's latest 20-MHz 386, a machine that tested well in the top half of similar 20-MHz models; 24-hour on-line support is another plus. One drawback is the machine's partial SMARTslot architecture, a design for which no one, not even AST, has yet announced plans to manufacture boards.

CIRCLE 413 ON READER SERVICE CARD

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Mac World

Tecmar's QT-Mac80™ and QT-Mac40™ are the proven choice for SCSI tape backup for the pure Mac environment, with network support for effective backup and archiving under TOPS,® AppleShare® and Novell.® Including our exclusive QuickTurn™ Quality Service and two-year warranty, you couldn't ask for a better Mac tape backup solution.

Applications Guide

	Apple® Macintosh®				IBM®/ Compatibles	
	Plus	SE	II	IIX	PC	PS/2™
QT-Mac40 40MB SCSI	●	●	●	●		
QT-Mac80 80MB SCSI		●	●	●		
QT-Mac150* 150MB			●	●	●	●
NuLink Interface			●	●		

*Bundled with NuLink for total MacII solutions. PC and PS/2 host adapter board also available. Call for details.

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We've even bridged the gap between PC Bus, Micro Channel™ Bus and NuBus™ with our new QT-Mac150™ and NuLink™ interface board, which now, for the first time ever, give you a single-drive solution for mixed environments.

So get the best for both worlds. For the name of your nearest dealer, call us today at **(216) 349-1009** or toll-free at **(800) 624-8560**. Tecmar, Inc., 6225 Cochran Road, Solon, Ohio 44139-3377.

CIRCLE 384 ON READER SERVICE CARD

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The three SMARTslots in the AST Premium/386C will accept standard AT and XT cards. But their main purpose is to enhance performance by unloading some of the CPU's work onto boards (as yet unavailable) that take advantage of their capabilities.

in a box 2 inches narrower than an IBM PC AT.

The unit we received sported a Western Digital controller capable of controlling two hard and two floppy disk drives, giving the system the ability to handle three floppy drives total. A CDC 90MB hard disk drive, AST's 16-bit video card, and an AST VGA monitor were also included for a list price of $6,995.

No RAM is located on the motherboard; instead, the cache memory and standard 1MB of 100-ns. SIMMs are found on a 32-bit memory board. If you use 1-megabit chips, you can pack the board with 16MB of RAM. This method saves you motherboard real estate and greatly simplifies the memory upgrade process.

SLOTS WITH AN IQ Besides the proprietary 32-bit slot, you get one AT-style 16-bit and two 8-bit slots. The other three 16-bit slots are what AST calls SMARTslots: specially designed expansion slots that can enhance overall system performance by unloading some of the processor's work onto boards designed to take advantage of the distributed processing.

The problem is that no one—not even the people at AST—has yet come out with the boards that will do this. Until someone does, you can just plug XT- or AT-compatible boards into the SMARTslots. (AST says that it does have plans for such boards in the works, but declined to be more specific.)

Our benchmark tests showed that the new and improved AST performed consistently in the top half, and frequently ranked in the top third of the machines in its range. It was nearly always well ahead of its IBM counterpart.

A grab bag of utility software to improve performance and help with diagnostics comes with the system. We found disk caching software, memory management utilities, RAMdisk software, and a print spooler. The documentation for these utilities and the machine's user manual were incomplete preliminary versions, but what was there looked good.

Also worth mentioning is AST's 24-hour support. If you have questions at any time of the day or night, you can get to an AST technician via a bulletin board—not much use if your only computer is down, but a great help otherwise.

The addition of cache memory enhances an already respectable system design. AST has always had a good name as a components manufacturer, and its latest machine seems to corroborate its growing reputation as a capable systems builder. The Premium/386C is well worth a look.
—Kate Emery

AT&T
AT&T 6386 WGS

While the argument in favor of desktop and large-sized personal computers usually centers around the number of expansion slots and drives these systems can handle, the intended market for AT&T's 20-MHz 6386 WGS ($3,495 base price) goes beyond users who just want a lot of elbow room.

WGS stands for Work Group System, referring to the system's ability to support up to 32 users and accommodate up to 48MB of 32-bit RAM. An indication of this machine's target market is that during last fall's AT&T sales campaign, every 6386 WGS sold came with a free terminal.

Running under Unix, the 6386 WGS's function is to serve primarily as a multiuser, multitasking machine for departmental workgroups or as a file server for a department-level network. The claim of 32-user support refers to the maximum number of users who can run their terminals at acceptable performance levels under a multitasking operating system using this computer as the primary CPU.

Of course, if you've a real yen to have some extra-heavy-duty hardware all to yourself, the AT&T 6386 WGS (which is actually made by Olivetti) is an interesting alternative. The WGS has a separate steel box that encases the main, hidden hard disk drive to minimize interference from stray radio-wave emissions. There's a huge fan that protrudes from the back of the system unit just to keep everything cool inside, clearly in expectation of the computer's being stuffed with heat-producing memory expansion and network cards. The expansion bus runs at 10 MHz; two 8-bit, two 16-bit, and three 32-bit memory expansion slots (each of which can hold memory cards filled with up to 16MB of DRAM) are included.

OLIVETTI INSIDES The Olivetti motherboard hosts the 20-MHz 386 chip; the Olivetti BIOS, Version 1.14; a floppy

The AT&T 6386 WGS is designed for heavy-duty, multiuser operation. A steel box encases the main hard disk to minimize radio-wave interference. A huge fan means you can stuff the unit with heat-producing memory and network cards.

PC MAGAZINE FACT FILE

AT&T 6386 WGS
AT&T
1 Speedwell Ave.
Morristown, NJ 07960
(201) 247-1212
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, $3,495; with 40MB hard disk, monochrome monitor, DOS 3.3, $5,290; with VGA monitor, $5,313; with 68MB hard disk, $6,913; with 135MB hard disk, $7,913. 1MB RAM upgrade, $749; 60MB tape backup, $1,495.
In Short: This very rugged machine looks larger than it actually is; it's intended to be used as a multitasking machine for departmental workgroups. Able to hold up to 48MB of 32-bit RAM, this one is probably too much machine for the needs of an individual user.
CIRCLE 412 ON READER SERVICE CARD

disk drive controller; and one parallel and one serial port. The system also offers zero wait states and the ability to shadow both BIOS and video ROM. The test machine included an 80387 math coprocessor, but the WGS will also support a Weitek 1167 chip.

On the test machine, a Western Digital 1:1 interleave ESDI hard disk controller ran an 80MB CDC hard disk drive. The Key Tronic Enhanced-style keyboard is passable but a bit soft.

On a pure speed basis, the WGS scored in the middle of the 20-MHz pack on our benchmark tests. Think of it as a large, fast, luxuriously equipped bus—not a swift sports car with room for only two.

The WGS is an expensive machine. The test configuration with 4MB of memory, an 80MB hard disk drive, an 80387 20-MHz coprocessor, and a combination 8- and 16-bit VGA display setup lists for $9,607, a pretty penny indeed. If you fill it up with memory, the unit can easily cost you more than $40,000, as each fully populated 16MB expansion card has a price of almost $12,000. It's hard to imagine this computer as a single-user system; it lacks the performance that engineering and desktop-publishing applications most need. But this system is a heavy-duty worker, and it should last a long time.
—Bruce Brown

BUS COMPUTER SYSTEMS
BUS 386/16
BUS 386/20
BUS 386/25

Bus Computer has been in business for the past 5 years, but in that time it has gone through at least two name changes. What may set the company apart from a host of other clone-makers, besides its chameleon identity, is its choice of components. All 386 machines purchased with 64K cache memory, like the ones we reviewed, are built around an American Megatrends Inc. (AMI) motherboard. Each base unit even comes standard with the fast and full-featured Distributed Processing Technology (DPT) controller card plus 512K disk cache, a combination that alone retails for over $1,200 (see the sidebar "Hard Disk Speed: The Cache Advantage").

The Bus 386 machines are available with three processing options. The 16-MHz computer, with a 1.2MB 5¼-inch floppy disk drive, one parallel and one serial port, 1MB of RAM, 64K cache memory, and an Enhanced-style keyboard, sells for $1,799. A 20-MHz model with the same configuration sells for $2,099. And the price of the 25-MHz base unit jumps to $3,650.

All Bus 386 models are built within a mighty tower encasement. There is an immense drive bay capacity that can accommodate a total of seven half-height devices. Front power and reset buttons sit alongside an LED with a 2-inch-high digital readout of your processor's current speed. This is probably most useful as a check when toggling down to the slower 8-MHz speed.

BUS 386/16 The tested Bus 386/16 was a conspicuous entry. Though an Intel 16-MHz microprocessor chip was mounted squarely in the middle of the motherboard, this machine ran consistently at 20 MHz in all our tests. Even the bus speeds were equal to those of the Bus 386/20, running at both 8 and 10 MHz. The Bus 386/16, in fact, fared much better than the 386/20 in the 80386 Instruction Mix test results.

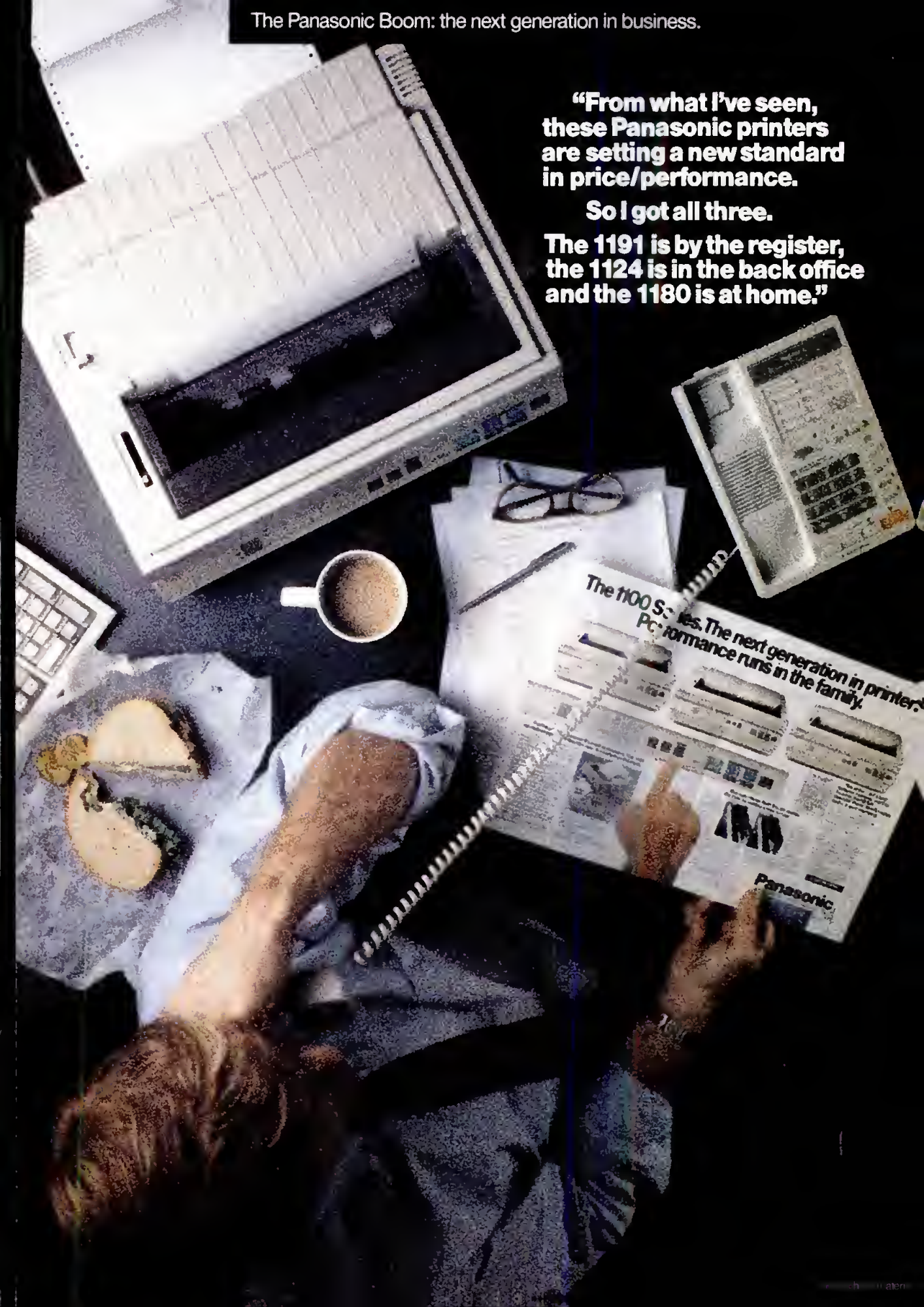
Some might consider Bus's strategy an effective way to achieve 20-MHz speed at a 16-MHz price. But there are two reasons why this deal is no bargain. First, Intel does not guarantee the integrity of its chip on computers running at higher speeds than the processor. Second, the 16-MHz model, in all configurations, is only slightly less expensive than the Bus 386/20. For instance, our test 16-MHz configuration, which differed mainly from the 20-MHz evaluation unit in terms of processor speed and hard disk size, was priced at $4,699, only a slim $300 less than the 386/20.

As far as we know, Bus Computer's advertising and marketing do not promote the faster speed rate achieved in the 16-MHz model, so it doesn't appear as if the company is trying to capitalize on the occurrence. If choosing between the two, though, be on the safe side and stick with the Bus 386/20 machine.

BUS 386/20 For instant adjustments and convenient testing, setup and diagnostic software are built into the ROM of all Bus computers. Shadow RAM is automatically invoked on these machines unless you toggle it off in setup. On the Bus 386/20, which came configured with 2MB of RAM, the 384K above the 640K base is reserved for BIOS and video enhancement—allowing only 1MB of available extended memory. The display update

Like the 16- and 20-MHz cache-RAM-equipped Bus towers, the Bus 386/25 is built around an AMI motherboard and comes standard with Distributed Processing Technology's fast disk controller with a 512K disk cache.

The Panasonic Boom: the next generation in business.



generation in printers.
ns in the family.

KX-P1180

Resident type fonts on all 1100 Series printers include draft pica and elite, letter-quality or near-letter-quality Courier, Prestige, Bold PS and Sans Serif. Plus Script on the 1124.

All these resident LQ or NLQ fonts are available in ten different character sizes.

And print speeds go from 38 to 63 cps in letter-quality/near letter quality. And from 160 to 240 cps in draft.

The 1100 Series printers also produce graphics as well as they handle text. Resolution is crisp, clear, precise. With bit image matrixes from 240x216 dpi to 360x360 dpi.

All of these features enhance your ability to create—and be creative.

The 1100 Series printers were designed for non-software experts.

The EZ-Set™ Operator Panel allows you to make choices simply and quickly—without having to program any software.

The ergonomic design presents you with settings for the features you use most. Fonts, pitch, form length and many more choices can be pre-set on the panel. And the 1124 even has a Macro feature that allows you to easily save and recall all the panel settings for three different formats.

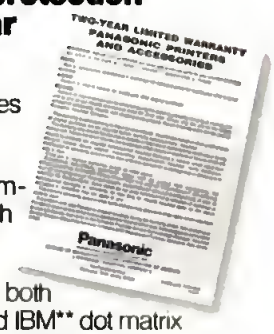
Selectable on the EZ-Set™ Operator Panel:

- Fonts: 4 to 6, depending on model
- Pitch: 4 to 6, depending on model
- Form Length: From 8" to 14"
- Quiet Mode: Cuts printer noise by 50%
- Micro Line Feed: forward and reverse
- Perforation Cut
- Self Test
- And more

The EZ Set™ Operator Panel puts features at your fingertips.

1124 printer shown.

Plus the protection of a two-year warranty.



The 1100 Series is a family of full-featured 24- and 9-pin printers. Compatible with the rich software libraries supporting both Epson* and IBM** dot matrix printers. And protecting your investment with something you'll find on very few printers out there: a two-year warranty*** on *both* parts and labor, from Panasonic.

That makes them good investments.

From any business perspective.

For more information on the 1100 Series printers or any of our other versatile computer products call:

1-800-PIC-8086

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**IBM is a registered trademark of International Business Machines Corporation

***The complete warranty is available for review at your Panasonic Dealer

Panasonic
Office Automation OA

Copiers, Typewriters, Printers, Peripherals and Facsimiles.

Folded edge of the page

GbsSlipSheet-001

Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
    1. Front side touching the free page
    2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet

Inverted Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
    1. Front side touching the free page
    2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet

1. Follow Instructions on the other side

Inverted Back

GbsSlipBack-0018

Back

1. Follow Instructions on the other side

The 1100 Series. The next Performance ru

KX-P1124

KX-P1191

A highly-sophisticated 24-pin. And two companion 9-pins. These are the remarkable dot matrix printers which make up the 1100 Series from Panasonic.®

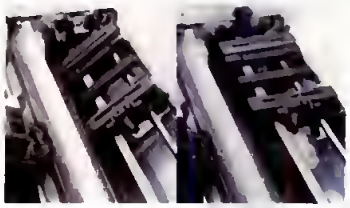
They'll meet your needs today—and tomorrow—with flexible paper handling, multiple resident fonts and unsurpassed ease of operation.

For the demands of the present, each 1100 Series printer offers advanced features, ergonomic design, and attractive prices to suit the requirements of a business, a department, an application or an individual.

For the demands of the future, the 1100 Series provides a smooth progression of printing capabilities to grow into...and grow along with.

Versatile paper handling to meet all of your needs.

In engineering the 1100 Series printers, Panasonic placed a high priority on paper handling. With that in mind, an ingenious push/pull tractor feed system was incorporated into the 1100 Series. The idea was not simply to accommodate a plethora of paper shapes, sizes and weights, but to allow the user to handle everything from single sheets to multi-part forms to fanfold paper—even envelopes and labels—quickly and easily.



1124 printer shown

All 1100 Series printers can accommodate single sheets in both landscape and portrait orientation.

So presentations incorporating graphics with text present no problem.

All 1100 Series printers offer multiple paper paths for continuous paper. And since paper can be fed from your choice of bottom or rear, you can put an 1100 virtually anywhere.

All 1100 Series printers have semi-automatic paper loading.

So sheets are perfectly positioned the first time in. All 1100 Series printers automatically locate the perforation on fanfold paper, bring the perf to the tear bar for easy tearing, and then position the next sheet of paper for printing. Without wasting a single sheet. And all 1100 Series printers have a 'paper park' capability. On demand, continuous paper is retracted and 'parked' so that sheet paper and envelopes can be loaded and printed without unloading—and wasting—the fanfold paper.

Only one paper path is available at any given time for continuous paper 1124 printer shown.

Thousands of ways to exercise creativity.

The variety of type styles, sizes and weights that can be created on any of the 1100 Series printers is staggering.

Draft Pica
Draft Elite
Courier Pica
Prestige Elite
Bold Proportional Space
Sans Serif Pica
Script Pica
(1124 only)

A minimum of 3400 combinations, in fact, can be created by combining resident fonts, character sizes and enhancement choices like italics, double height, bold face, underlined, super- and subscript.

The Panasonic 1100 Series Printers.

Match your needs against these:

KX-P1124
24-Pin Printer

Print Speed:
(Characters/second)

	Draft	LQ
Elite	192 cps	63 cps
Pica	160 cps	53 cps

Letter Quality Fonts:
Courier, Prestige, Bold PS, Sans Serif, Script

Resolution:
Draft—24 x 9
LQ —24 x 30

Bit Image (matrix):
360 x 360 dpi

EZ-Set Operator Panel:
Primary functions include:

Font	Lines Per Inch
Pitch	Quiet Mode
Form Length	Perforation Cut
Paper Loading	Paper Parking
3 Macro Settings	Margin Settings
Micro Line Feed	Default Setting

Tractor Type:
Push/pull, swivel mount, flat belt

Paper Feed:

Path	Method
Top	Cut Sheet Feeder (opt)
Rear	Push Tractor
Bottom	Pull Tractor
Front	Friction or Pull Tractor

Emulations:
Epson LQ-2500; IBM Proprinter X24

Buffer:
6K (std); 32K (opt)

Noise Level (LQ Mode):
56 dbA (Standard);
53 dbA (Quiet Mode)

Dimensions:
16.9 (w) x 14.1 (d) x 5.6 (h) inches
18.7 lbs

Options and Accessories:
Cut Sheet Feeder (KX-P36)
RS-232C Serial Interface (KX-P19)
32K Expansion Buffer Chip (KX-P43)
Re-Inking Fabric Ribbon (KX-P145)

KX-P1191
9-Pin Printer

Print Speed:
(Characters/second)

	Draft	NLQ
Elite	240 cps	48 cps
Pica	200 cps	40 cps

Near Letter Quality Fonts:
Courier, Prestige, Bold PS, Sans Serif

Resolution:
Draft—9 x 9
NLQ (Sans Serif)—18 x 9
NLQ (All others) —18 x 18

Bit Image (matrix):
240 x 216 dpi

EZ-Set Operator Panel:
Primary functions include:

Font	Bold Mode
Pitch	Quiet Mode
Form Length	Perforation Cut
Micro Line Feed	Italic Mode
Line Feed	Form Feed
Lines Per Inch	Margin Settings

Tractor Type:
Push or pull pinwheel

Paper Feed:

Path	Method
Top	Friction/Cut Sheet Feeder (opt)
Rear	Push Tractor
Bottom	Pull Tractor

Emulations:
Epson FX-86e; IBM Proprinter II

Buffer:
6K (std); 32K (opt)

Noise Level:
55 dbA (Standard);
52 dbA (Quiet Mode)

Dimensions:
16.7 (w) x 13.4 (d) x 5.2 (h) inches
15.7 lbs

Options and Accessories:
Cut Sheet Feeder (KX-P37)
RS-232C Serial Interface (KX-P19)
32K Expansion Buffer Chip (KX-P43)
Re-Inking Fabric Ribbon (KX-P115)

KX-P1180
9-Pin Printer

Print Speed:
(Characters/second)

	Draft	NLQ
Elite	192 cps	38 cps
Pica	160 cps	32 cps

Near Letter Quality Fonts:
Courier, Prestige, Bold PS, Sans Serif

Resolution:
Draft—9 x 9
NLQ (Sans Serif)—18 x 9
NLQ (All others) —18 x 18

Bit Image (matrix):
240 x 216 dpi

EZ-Set Operator Panel:
Primary functions include:

Font	Line Feed
Pitch	Quiet Mode
Form Length	Perforation Cut
Micro Line Feed	Form Feed

Tractor Type:
Push or pull pinwheel

Paper Feed:

Path	Method
Top	Friction/Cut Sheet Feeder (opt)
Rear	Push Tractor
Bottom	Pull Tractor

Emulations:
Epson FX-86e; IBM Proprinter II

Buffer:
2K (std); 32K (opt)

Noise Level:
55 dbA (Standard);
52 dbA (Quiet Mode)

Dimensions:
16.7 (w) x 13.4 (d) x 5.2 (h) inches
14.1 lbs

Options and Accessories:
Cut Sheet Feeder (KX-P37)
RS-232C Serial Interface (KX-P19)
32K Expansion Buffer Chip (KX-P43)
Re-Inking Fabric Ribbon (KX-P115)

Panasonic
Office Automation OA

CPD6020

FACT FILE

Bus Computer Systems
135 W. 26th St.
New York, NY 10010
(800) 451-5279
(212) 627-4485

Bus 386/16
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, $1,799; with 60MB hard disk, monochrome monitor, DOS 3.3, $2,850; with VGA monitor, $3,350; with 2MB RAM, 70MB hard disk, 1.2MB 5¼-inch and 1.44MB 3½-inch floppy disk drives, 80387 coprocessor, $4,699. 1MB RAM upgrade, $450; 150MB hard disk, $1,500; 60MB tape backup, $675.
CIRCLE 606 ON READER SERVICE CARD

Bus 386/20
List Price: 1MB RAM, 1.2MB 5¼-inch floppy disk drive, $2,099, with 60MB hard disk, monochrome monitor, DOS 3.3, $2,950; with VGA monitor, $3,450; with 2MB RAM, 100MB hard disk, 1.2MB 5¼-inch and 1.44MB 3½-inch floppy disk drives, $4,999. 1MB RAM upgrade, $450; 150MB hard disk, $1,500; 60MB tape backup, $675.
CIRCLE 607 ON READER SERVICE CARD

Bus 386/25
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, $3,650; with 60MB hard disk, monochrome monitor, DOS 3.3, $4,325; with VGA monitor, $4,825; with 4MB RAM, 330MB hard disk, 1.2MB 5¼-inch and 1.44MB 3½-inch floppy disk drives, 80387 coprocessor, $8,999. 1MB RAM upgrade, $450; 60MB tape backup, $675.
CIRCLE 608 ON READER SERVICE CARD

In Short: Built with quality components, these tower-sized systems offer such features as a superfast DPT controller card with 512K built-in disk cache and, as an option, 64K of cache memory. Though base prices are reasonable, the systems are a better bargain with each option added.

rates, however, will increase in excess of 100 percent with shadow RAM enabled. This is particularly valuable when you are using screen-intensive applications like CAD/CAM software.

Besides the 2MB of RAM, the tested 386/20 included a number of high-quality components, such as a 100MB Priam hard disk, Video Seven 16-bit VGA color adapter, and NEC MultiSync II monitor, plus 3½-inch and 5¼-inch floppy disk drives, at a list price of $4,999.

The AMI Mark II XT 386 motherboard used in this configuration is unable to accept memory directly. Instead, the architecture incorporates an accompanying 32-bit card with capacity for 8MB of memory. Another 8MB can be loaded via a daughtercard, thus bringing the total 32-bit memory to 16MB.

Theoretically, this motherboard could take up to 64MB of RAM using 4-megabit chips. By the same token, the AMI Mark II AT motherboard used in the 25-MHz machine could hold up to 96MB. AMI cautions you, though, that not only is the 4Mb chip presently in short supply, but the ones that are available haven't been around long enough for the company to test both their integrity over time and their compatibility with the AMI boards.

But there are plenty of other features to recommend the AMI motherboard, like 64K of built-in cache memory controlled by a proprietary discrete logic. And the eight full-size slots allow enough expansion to suit most users. On top of that, the unit did well on our benchmark tests, garnering midlevel to high scores on most tests. Fortunately for the Bus 386/20, it is a machine equal to the sum of its parts.

BUS 386/25 One of the most outstanding buys in its class, the Bus 386/25 we tested came equipped with robust features: a monstrous 330MB Priam fixed disk, 1.2MB 5¼-inch and 1.44MB 3½-inch floppy disk drives, the same VGA complement as the Bus 386/20, and the standard 4MB of RAM—all for under $9,000.

The AMI motherboard on this model runs the AMI Mark II AT 386 BIOS. This version of the AMI motherboard is more intelligent than the AMI Mark II XT used in the Bus 386/16 and Bus 386/20 models. The Mark II AT will automatically find memory as it's added, whereas the Mark II XT requires manual switch adjustment on the motherboard.

The Bus 386/25 performed in the mid-to-high range of machines in its class. The fast DOS File Access times (small-record) can be attributed to the DPT controller. Though impressively fast in this one category, the controller probably won't directly affect the speed of most applications. As the Bus 386/25 is a strong performer overall, it was doubly puzzling to see an amazingly slow transfer speed between the hard disk and the 5¼-inch TEAC floppy disk when doing some routine file copying. When stacked up against the unit's other features, however, this one annoyance is less outstanding.

EXTRA VALUE FOR NETWORKS Because of their standard components, the Bus 386 line of computers exhibits promising quality at reasonable prices—especially as you add more options. You get extra value, for instance, if you plan to use one of the Bus machines as a Novell file server and choose any Priam hard disk to go along with it. Priam ships its hard disks Novell NetWare-ready: they are preformatted with DOS or Xenix and have had Novell COMPSURF run on them at Priam's own testing lab. This saves you several days of testing prior to installing the network software.

The Bus 386/20 did well on our benchmark tests and is a machine equal to the sum of its parts.

In particular, the combination of the Priam 330MB hard disk (which alone retails for $3,000) and the Bus 386/25 gives you outstanding network capacity at top speeds for an unbeatable price. Throw in a tape backup unit, and this configuration has server written all over it.

The 20- and 25-MHz models represent particularly good buys whether you plan to use them as servers or not. Good prices, excellent features, and high speed make them well worth a look.—**Tami Peterson**

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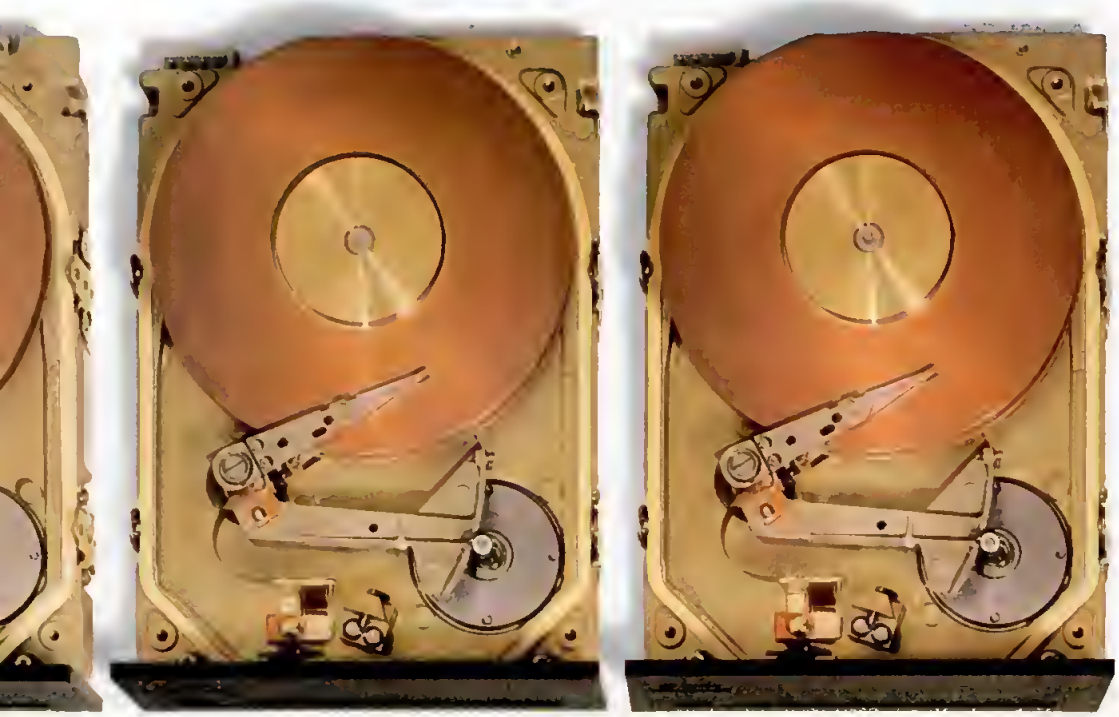

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CANON USA INC.
CANON A-200SX

Canon largely controls the personal copier world and also makes the laser printing engine used by many vendors, including standard-setting Hewlett-Packard. But it won't capture the 386 market with its lone offering, the A-200SX. On the plus side, the unit (actually an Acer Technologies 16-MHz machine with a new case) is fast, but its high price and lack of system expansion options through Canon's own dealers are problems too significant to ignore.

The desktop-sized machine is available in one $5,500 configuration only, with 1MB of motherboard RAM and a 40MB MiniScribe hard disk drive. The one option is an EGA video card and Acer monitor combination that, at $980, brings the total system price to $6,480. The only other item you can buy from Canon for this computer is a set of DOS manuals for an extra $140. (DOS and GW-BASIC software are included in the base price.)

The A-200SX also includes two serial ports and one parallel port, a 5¼-inch 1.2MB floppy disk drive, and a 200-watt power supply with five device power connectors. The case will take five half-height storage devices with three exposed for removable media. The 101-key, Enhanced-style keyboard, also made by Acer, has a nice clicky touch, although it may feel a bit loose to some people.

The motherboard is Acer's and the BIOS is Award's, Version 2.02. Despite the inclusion of the letters SX in the machine's name, it uses an honest-to-goodness 80386, 16-MHz chip. There are eight expansion slots—two 8-bit, five 16-bit, and one proprietary 32-bit slot for memory expansion. Right off you have a problem—the 32-bit slot will stay empty if you rely on Canon to fill it. Fortunately, any Acer dealer will sell you Acer's memory expansion boards, which work just fine. The Canon can take up to 4MB of RAM on the motherboard and a total of 16MB using memory expansion cards.

The Canon A-200SX is really an Acer Technologies machine with a new case. Canon offers only an EGA card/monitor option for its base configuration; to fill the 32-bit memory slot, you'll have to turn to Acer.

MORE ALIKE BY THE LOOK The similarities with the Acer machine go on and on. The Canon uses Acer's SmartMode processor control, which slows down the system to 8 MHz when floppy disk drives are accessed. If your software isn't picky, you can turn off the SmartMode. You can also turn on or off shadow RAM loading of video and ROM BIOS. The Canon A-200SX did well in our benchmark testing, scoring right along with the Acer 16-MHz version in the upper half of the 16-MHz machines.

Canon's stated intention of limiting configuration alternatives so as not to initially overwhelm the customer with tough choices doesn't help much when the customer needs support or is ready to add on other equipment. And it won't help Canon's public relations when the customer finds that the Acer dealer who can provide him with the expansion options he needs also sells a computer similar to the one he bought, only with more memory, a larger hard disk drive, and a VGA monitor—for about a thousand dollars less.

Worse yet, he may notice that for a few hundred dollars less than what he spent, he could have gotten a 20-MHz Acer 386. Oops.—**Bruce Brown**

PC MAGAZINE FACT FILE

Canon A-200SX
Canon USA Inc.
1 Canon Plaza
Lake Success, NY 10042
(516) 488-6700
List Price: With 1MB RAM, 40MB hard disk, 1.2MB 5¼-inch floppy disk drive, DOS 3.3, $5,500; with EGA monitor, $6,480.
In Short: Canon charges too much for this repackaged Acer 16-MHz computer. It's a fine machine, but Canon offers no expansion options and support is questionable. Buy an Acer instead.
CIRCLE 404 ON READER SERVICE CARD

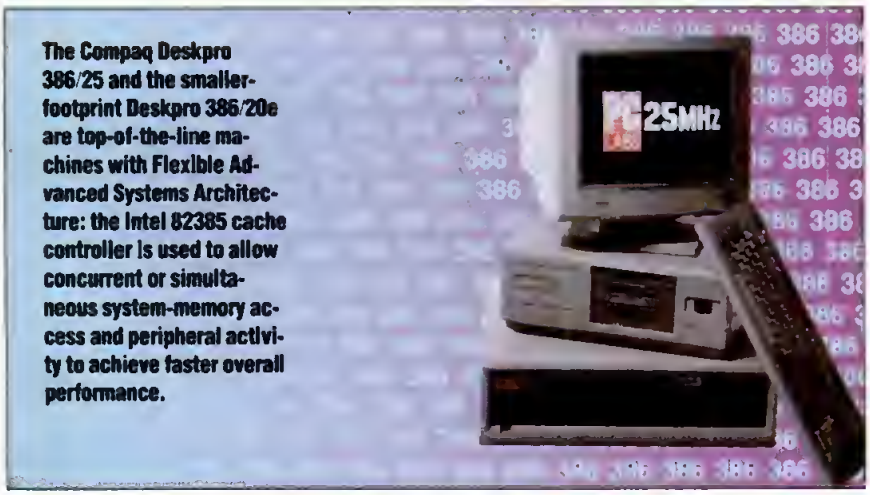
COMPAQ COMPUTER CORP.
COMPAQ DESKPRO 386/20E
COMPAQ DESKPRO 386/25

Compaq has a reputation to maintain as a technological and market leader. Fittingly, its top-of-the-line Deskpro 386/20e and Deskpro 386/25 are stocked with first-class components and distinguished by solid engineering. The other side of the story is that Compaq's pricing has always been on the high side—$5,199 for the 20-MHz base system and $8,299 for the basic 25-MHz unit.

The Deskpro 386/20e and 386/25 both run on Flexible Advanced Systems Architecture, a method that uses the Intel 82385 cache controller chip to allow concurrent or simultaneous system memory access and peripheral activity. The result of the extra hardware is faster overall performance in real-world tasks.

Both base machines come with Compaq's own motherboard and BIOS, 1MB of 32-bit RAM, one 1.2MB floppy disk drive, one parallel and one serial port, and sockets for 80387 or Weitek coprocessors (the 386/25 can use both at the same time). They share a similar keyboard—the cases are different, but the keys have the same uninspired soft touch.

Compaq offers a range of enhancement options, but be careful about what you're getting. The list price of either configuration with the maximum available memory, hard disk and tape storage, highest-quality video, and math coprocessor could easily exceed $20,000. An example of the price



The Compaq Deskpro 386/25 and the smaller-footprint Deskpro 386/20e are top-of-the-line machines with Flexible Advanced Systems Architecture: the Intel 82385 cache controller is used to allow concurrent or simultaneous system-memory access and peripheral activity to achieve faster overall performance.

premium Compaq imposes is the cost of the Intel 80387 25-MHz math coprocessor. Other vendors sell the same chip for $600 to $1,200; Compaq's list price is $1,899.

DESKPRO 386/20E The first thing you notice about this machine is its small-footprint case, approximately 6 by 16 by 15 inches (HWD). The beauty of this unit is that you have to give up neither your desktop nor expansion options.

The 386/20e contains four internal storage devices, although only three can have exposed fronts. An optional external expansion chassis to handle 300MB drives is also available. And with 4MB of RAM on the motherboard and 12MB more on an expansion card, you can add up to 16MB of 32-bit memory.

The Compaqs are impressive, but they don't come cheap.

Even after adding in the 32-bit memory card, you'll still have four 16-bit slots left. This is plenty for most people, especially since the 386/20e motherboard has built-in parallel, serial, and mouse ports, as well as floppy disk and hard disk drive controllers and a VGA adapter. The 175-watt power supply is more than sufficient for the slots, drives, and loaded memory.

The 32K of 35-nanosecond cache memory works with the standard 100-ns. memory chips to yield excellent performance; both processor and memory benchmark test scores were in the top quadrant of 20-MHz machines.

While you can certainly load up this small bucket with an impressive array of options, it can get expensive. The list price of the test configuration machine, with DOS, a 110MB hard disk drive, an 80387-20 math coprocessor chip, a second floppy disk drive, a 40MB internal tape backup device, a Compaq VGA monitor, and only 2MB of RAM, came to $11,191—plenty there, but it doesn't come cheap.

DESKPRO 386/25 The 25-MHz Deskpro 386/25 is a full-size desktop machine with eight expansion slots and room for four storage devices, all of which can use removable media. Four devices for this machine may not seem like much until you look at the sizes of the 386/25's available hard disk drives, the largest of which is a whopping 300MB.

You can put up to 12MB of 100-ns. 32-bit memory on the motherboard before adding 4MB more onto a memory card. Compaq doesn't use RAM shadowing, but it does use memory interleaving to help performance. And the 32K of 29-ns. static RAM cache (operating under the 25-MHz Intel cache controller) provides zero-wait-state performance over 90 percent of the time.

In our benchmark tests, the 386/25 scored reasonably well compared with other 25-MHz 386s, but the narrow performance envelope in which these computers are competing tends to distort comparisons. As long as a computer falls within the normal range of scores in its class, which the 386/25 does, you're dealing with a very fast unit.

The test configuration machine had 5MB of RAM, an ESDI controller and 300MB hard disk drive, a 135MB tape backup unit, a 16-bit Compaq video adapter and monitor, and the 80387-25 coprocessor. The list price, including DOS, is a lofty $21,614.

PC MAGAZINE FACT FILE

Compaq Computer Corp.
20555 FM 149
Houston, TX 77070
(713) 370-0670

Compaq Deskpro 386/20e
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk, $5,199; with 40MB hard disk drive, monochrome monitor, DOS 3.3, $6,974; with VGA monitor, $7,418; with 2MB RAM, 110MB hard disk, 40MB tape backup, 1.2MB 5¼-inch and 1.44MB 3½-inch floppy disk drives, 80387-20 coprocessor, $11,191. 1MB RAM upgrade, $799.
CIRCLE 396 ON READER SERVICE CARD

Compaq Deskpro 386/25
List Price: With 1MB RAM, 60MB hard disk, 1.2MB 5¼-inch floppy disk drive, DOS 3.3, $8,299; with monochrome monitor, $8,674; with VGA monitor, $9,717; with 5MB RAM, 300MB hard disk, 135MB tape backup, 80387-25 coprocessor, $21,614. 1MB RAM upgrade, $799.
CIRCLE 397 ON READER SERVICE CARD

In Short: Compaq was the first on the market with a 386 computer and has earned increasing influence since. Compaq's experience and clout show in both computers reviewed: the very hot 386/25, which can support 1.2 gigabytes of storage, and the small-format 386/20e, a dream personal machine. These are both terrific computers—it's a shame they have to cost so darned much.

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It's hard to picture the average individual needing the performance of this machine, although those involved in engineering and graphics applications can use all the memory and speed they can get. More likely, this computer is best used as a network file server or for dedicated transaction processing.

Compaq computers are sold only through dealers; choose yours carefully, as it's up to him to support you for the 1-year warranty period. One drawback to Compaq's proprietary design and peripherals is that if something breaks, replacement costs are usually high.

However, given Compaq's increasing influence in its target corporate market (revenues roughly doubled in its last fiscal year), it appears that price is less of an issue than quality. And with the 386/25 and the 386/20e systems, the quality shines through.—**Bruce Brown**

COMPUADD CORP.

COMPUADD 386/16
COMPUADD 386/20
COMPUADD 386/25

In the past, mail-order computer firms competed solely on price, often at the expense of extra features and performance. But times have changed, and the smart mail-order companies, following the lead of companies like CompuAdd, now offer low-priced systems that are quality performers as well. CompuAdd's 16-MHz 386 has been on the market since early 1988, and this year the company introduced both 20- and 25-MHz 386 machines as well. Each system comes packed with features—and at prices that won't empty your savings account.

Like the 20- and 25-MHz systems, the CompuAdd 386/16 comes standard with 1MB of RAM, a 1.2MB floppy disk drive, and Western Digital ST-506 floppy/hard disk controller for $1,895. Also included with each model are three accessible half-height drive bays and two internal bays.

We received U.S.-made Key Tronic 101 keyboards with our systems; they gave a good tactile response without annoying key clicks. Our test 16-MHz unit also came with a 71MB MiniScribe drive, a 14-inch Goldstar VGA monitor and an 8-bit Video Seven VGA board, but CompuAdd offers a multitude of drive and video options.

A CLOSER LOOK A reset switch, cylindrical system lock, and three LEDs indicating power on, hard disk activity, and speed mode are all situated on the front of all three CompuAdd units. The turbo light isn't used on the 16-MHz model, however, so without knowing otherwise you

BUYING SMART: THE RIGHT SYSTEM FOR YOUR NEEDS

God invented tourists, it's been said, because somebody has to pay retail. But no PC buyer should act as if he's on vacation when investing several thousand hard-earned dollars in a 386 system. Beyond Rule Number 1 of buying computers—"Never pay retail"—here are some other guidelines to keep in mind when you're shopping for a 386.

20 MHz is your best buy. When you're used to an 8-MHz AT, everything seems fast. But once you work with 16-, 20-, and 25-MHz 386 PCs, you'll notice three distinct tiers of performance. And you'll find yourself happier running your applications on something quicker than a 386-16.

Of the three, a 20-MHz 386 offers the best bang for the buck. You'll only save 10 to 15 percent dropping back to a 16-MHz 386. And 25 MHz, nice as it is, typically bumps the price up by a third (for instance, from $8,000 to $11,000 list for an IBM or Compaq system).

Case size. How many drive bays do you need? A small-footprint PC has three half-height drive bays stacked atop each other, a standard desktop has up to five, and a tower offers six or more. Floppy disk drives are half-height, and hard disks are typically half-height through 60MB; full-heights are usually over 100MB. It's not unreasonable to equip a PC with two floppy disk drives, a full-height hard disk, and either a full- or half-height tape backup device. That's tower territory.

Tower PCs are neater because the jumble of cables is out of sight under the desk; my own PC has 14 cables. Between small-footprint desktop PCs (with disk drive bays one across) and wide-body desktop PCs (bays two across), you'll find the extra width buys you marginally greater flexibility.

You need 3 to 4 *free* slots. What took a slot in your AT may well be on the motherboard in your 386, so pay less attention to total expansion slots than to slots free after you've accounted for memory, video, disk controller, and ports. Most users will want three free slots—for modem, network card, and bus mouse (if not located on the motherboard).

More than a few users will find the three free slots on an IBM Model 70 to be one too few, since one of the slots is for memory expansion. It's not inconceivable that you'll need space for a card controlling a scanner, a printer-speedup device, a second video card, or a CD-ROM drive. (Note: A single card controls both floppy and hard disks on ATs and 386 PCs with smaller, ST-506 drives. ESDI and SCSI hard disks typically require a separate slot for the controller.)

Buy 2- to 4MB of RAM. Even running DOS, 1MB of memory just isn't enough, as it hasn't been for most AT us-

could be fooled into thinking that you're always operating in slow mode.

You'll find the chassis on all the systems to be very flexible; when I moved the 16-MHz unit with the cover off (not a good idea), one of the boards came loose. But with the cover screwed on tightly, none of the boards came unseated during a move. Aside from the chassis, all the other components used in each model are well-constructed, brand-name items. All three machines earned an FCC Class B rating, making them suitable for both home and office use—no small feat for the price of these machines.

An Intel 80386 chip, rated at 16 MHz, is featured on the 386/16's Micronics motherboard. The motherboard also sports two 8-bit expansion slots, five 16-bit slots, and one Compaq-compatible 32-bit slot holding a Micronics 32-bit memory card. In the base configuration, only 256-kilobit DRAMs are on the motherboard; to back this up, 1MB of 100-nanosecond chips was soldered onto the memory card in the unit we received in the Labs for testing. If you'll be running OS/2 or any other memory gulper, a piggyback expansion card can bring the maximum installable memory to 10MB.

Page-mode memory is used in the CompuAdd 386/16 to achieve speedy zero-wait-state operation.

Both the Intel 80287 and 80387 math coprocessors are supported, but the 80387 requires a proprietary piggyback board from CompuAdd. The BIOS is the Award 386, Version 3.03.

Page-mode memory is used in the 386/16 to achieve speedy zero-wait-state operation. To speed up operation of the system and video BIOS further, you can specify 384K to be used as shadow RAM. While the processor and BIOS routines are chugging away at 16 MHz, the data bus always runs at a safe 8 MHz. For those picky network cards, an 8-MHz bus is a godsend.

The additional RAM and video options on the 386/16 we received brought the price up to $3,917. But keep in mind that your dollars get you a fully configured sys-

ers. Get *at least* 2- to 4MB. In addition to the 640K for DOS, devote 1- to 2MB to a disk cache and/or RAMdisk. (Hard disk caching, the preferred route, improves the performance of any disk.) Use additional memory for expanded memory and to work under multitaskers such as *DESQview 386* or *Microsoft Windows/386*.

Hard disks. Disks are commonly rated by capacity (megabytes) and average access speed (milliseconds, or thousandths of a second). By way of comparison: XTs had 10MB 85- to 110-ms. hard disks; PC ATs had 20- or 30MB 40-ms. ST-506 hard disks.

For your 386, the smallest hard disk you should install is a 40- or 60MB 30-ms. hard disk. A better match for 20- and 25-MHz 386s would be a 90- to 120MB 20-ms. ESDI (Enhanced Small Device Interface) drive. Expect to pay $750 to $1,500 more than you would for the 40MB drive.

Get high-density floppies. If you opt for a 3½-inch floppy disk drive as your second drive, be sure to get the high-density 1.44MB drive rather than the 720K drive. It costs only a few dollars more and writes 720K floppies reliably (unlike the 1.2MB 5¼-inch drives, which often have trouble with 360K floppies). Most vendors let you specify either 5¼ or 3½-inch drives if you equip your machine with only one.

Buy only VGA (or Super VGA). EGA is a dying video standard. VGA is good; Super VGA, better. Also called Extended VGA or VGA Plus, Super VGA has 800 by 600 resolution (VGA has 640 by 480; EGA, 640 by 350) and automatically runs VGA or EGA on programs lacking Super VGA drivers. Best of all, Super VGA costs only a few dollars more than VGA. While VGA is supposed to cost the same as EGA (we've been promised that for 2 years now), among companies that still sell both, an EGA board/monitor combination is $100 to $200 cheaper. Stick with VGA or VGA Plus.

Once the NEC-led Video Electronics Standards Association (VESA) consortium settles on one 800 by 600 standard, Super VGA will make even more sense to users. Boards supporting VESA will likely work with far more software than nonconformers. And with luck, hardware upgrades should allow existing 800 by 600 VGA boards to speak VESA.

Monitor do's and don'ts. You don't have to buy your monitor from the company that makes your PC. Zenith's 1490 flat tension mask monitor is the best VGA monitor you can buy. Unfortunately, it cannot accommodate Super VGA. Among Super VGA–capable monitors, *PC Magazine*'s Editor's Choice monitors are the NEC MultiSync Plus ($1,399) and the Taxan MultiVision 770 Plus ($915), with honorable mention to the $699 Samsung Sync Master (see "Multiscanning Monitors for VGA and Beyond," *PC Magazine*, May 16, 1989). All are multiscanning monitors. As 800 by 600 takes hold, expect to see dual-frequency monitors that support both VGA and Super VGA. These should be cheaper than multiscanners. One of the first is NEC's MultiSync 2A, at $799.

How good are IBM and Compaq monitors? IBM's $685 8513, with a 12-

(continues)

tem, and the price is still well below much of the competition.

MORE FOR YOUR MONEY For $4,858, only $941 more than the cost of a fully configured 386/16, you can buy CompuAdd's midrange 386/20. The extra dollars buy you not only an increase in processor speed and disk storage (through a 70MB MiniScribe hard disk), but also a superb Zenith flat-screen VGA monitor, the 16-bit Paradise VGA, faster RAM, and one parallel and two serial ports on the motherboard. On top of that, you get a machine that was entirely designed and built by CompuAdd.

In fact, the new 386/20 and 386/25 models both have a CompuAdd motherboard with eight slots: one 8-bit, six 16-bit, and one proprietary 32-bit slot containing a CompuAdd 32-bit memory card. Unlike the motherboard on the 386/16, the CompuAdd motherboard has one parallel port, two serial ports, and an IDE (integrated drive electronics) hard disk drive controller built in. These integrated features save you valuable expansion slots.

CompuAdd's top-of-the line 386/25 (like its 20-MHz sibling) was designed and built by the company. To save slot space, the proprietary motherboard has one parallel and two serial ports, and a hard disk controller built in.

The 386/20 motherboard contains an Intel 80386 processor and an Austek cache controller with 32K of high-speed static RAM, both rated at 20 MHz. The cache controller enables the processor to operate at zero wait states. The motherboard also supports both the Intel 80387 and Weitek 3167 math coprocessor chips, which you'll need if you're running math-intensive programs.

Both newer 386s use the Award 386 BIOS, Version 3.04. Award's 386 BIOS performs memory diagnostics during start-up; it also includes a ROM-based setup that is accessed by pressing Ctrl-Alt-Esc at power-on.

To accommodate some speed-sensitive expansion boards, the bus can be set to 6.6 or 10 MHz using either the SETUP or SETSPEED program. Although some flexibility in bus speeds is allowed, some

("Buying Smart" continued)

inch diagonal, is too small, and the 8512 (14-inch diagonal, $595) is too fuzzy. If you have to pick one, take the 8513. Compaq's Video Graphics Color Monitor ($699) is adequate. Some companies, especially direct-mail companies, offer two levels of VGA monitor; invariably, you should buy the more expensive one.

If you're on a budget, consider a monochrome VGA monitor. You get 64 shades of gray (great for desktop publishing) for about $250. The same VGA card will drive a color monitor if you move up later.

Buy a 16-bit VGA card. Most makers offer three levels of VGA card: 8-bit bus, 16-bit bus, and 16-bit with costly, higher-speed VRAM memory chips. Then you'll have a choice of VGA (640 by 480), Super VGA (800 by 600), and in some cases super-Super VGA (1,024 by 768, the same resolution but not the same standard as IBM 8514/A), and 256- or 512K of video memory. Best bang for the buck: the 16-bit Super VGA version with 512K memory, which allows 16 colors at 800 by 600.

If you're sold on Super VGA, you should think twice about buying PCs with VGA on the motherboard. That includes all IBMs, the Compaq Deskpro 386/20e, Tandy 5000 MC, and many of the 386SX PCs. You may be able to disable or replace the VGA controller, but even if you can, you'll be paying twice for your video.

Get an internal modem. Allocate one slot for a 2,400-bit-per-second internal modem. A 2,400 is marginally more expensive than 1,200 bps now—100 percent more performance for 20 to 50 percent more money. Internal modems are cheaper than external and create less desk clutter, though it's true that you can't watch the status lights and you can't hit the modem power switch when you get in trouble. Keep your eye on single-slot 9,600-bps-fax-board/2,400-bps-modem combos. Before long, you'll see some for under $500.

Mice and serial ports. You're going to be using a mouse sooner or later. The places to connect your mouse, in descending order of preference: a bus connection on the motherboard, a bus card, and a serial port. If you choose Microsoft's best-selling mouse, a bus connection eliminates the need for Microsoft's dopey serial interface box. A bus card takes up a slot, so your best bet is a PC with a mouse connector on the motherboard. Why avoid serial mice? Most PCs have only two serial ports to share among as many as four serial devices. Cable swapping quickly becomes tiresome.

Questions about mail order.

Q: Are you using the manufacturer's specified hard disk? Sometimes it's replaced by someone else's drive, which isn't necessarily a drawback but costs the dealer less. There's no reason you shouldn't see some of the savings.

Q: Do you have a 30-day money-back guarantee?

Q: Do you have carry-in local service or on-site service? Shipping the PC back gets expensive. Besides, many "equipment failures" are nothing more than an incomplete setup.

Q: Do you charge extra for paying by credit card? Do you give a discount for cash? Mail order is extraordinarily ethical, but if you do run across scoundrels,

trial and error will be needed with older expansion boards that require a genuine 8-MHz bus.

A full 1MB of 100-ns. SIMMs comes standard on the memory card (although the evaluation 386/20 came with 2MB of 60-ns. SIMMs). On both the 386/20 and 386/25, RAM is expandable to a whopping 16MB using 1MB SIMMs. This should be plenty, even for the most memory-hungry applications.

TOP-OF-THE-LINE The 386/25 is CompuAdd's top-of-the-line PC, and when fully configured, it holds its own against some of the more expensive competition. Our evaluation unit had a 1.2MB floppy disk drive, a 320MB hard disk drive, a Zenith 14-inch flat-screen VGA monitor, 16-bit Paradise VGA, 4MB RAM in 60-ns. 256K SIMMs, 25-ns. static RAM in the cache controller, and one parallel and two serial ports. It was priced at $8,290.

you have leverage via your bank if you avoid any discount for paying by bank check.

Q: What else do I need to buy? (Is DOS included in the price? Is the cable included if you buy a printer or modem? Are the toner cartridge and drum supplied if you buy a laser?)

Compare apples and apples. If you're proposing to upgrade your office to 386-based machines, don't make 286 PCs look unfairly cheaper when you compare the pros and cons. Too often, ATs are priced equipped with 30- to 40MB hard drives and 1MB of RAM, while the 386 you're comparing may be listed with a 60- to 110MB drive and 2- to 4MB of RAM. The real cost of a PC includes the base PC *plus* memory, a video card, monitor, hard disk, mouse, printer, network adapter card, software, blank floppy disks, training, and maintenance. Only the system unit (and to some degree the memory) costs more for a 386 than for a 286.—**Bill Howard**

Bill Howard is an executive editor of PC Magazine.

PC MAGAZINE FACT FILE

CompuAdd Corp.
12303 Technology Blvd.
Austin, TX 78727
(800) 666-1872
(512) 250-1489

CompuAdd 386/16
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, $1,895; with 70MB hard disk, monochrome monitor, DOS 3.3, $2,731; with VGA monitor, $3,406; with 2MB RAM, $3,917. 1MB RAM upgrade, $560; 150MB hard disk, $1,599; 60MB tape backup, $757.
CIRCLE **399** ON READER SERVICE CARD

CompuAdd 386/20
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk, $2,295; with 70MB hard disk, monochrome monitor, DOS 3.3, $3,082; with VGA monitor, $4,315; with 2MB RAM, 110MB hard disk, $4,858. 1MB RAM upgrade, $495; 150MB hard disk, $1,599; 60MB tape backup, $757.
CIRCLE **400** ON READER SERVICE CARD

CompuAdd 386/25
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, $2,895; with 70MB hard disk, monochrome monitor, DOS 3.3, $3,682; with VGA monitor, $4,637; with 4MB RAM, 320MB hard disk, $8,290. 1MB RAM upgrade, $549; 150MB hard disk, $1,599; 60MB tape backup, $757.
CIRCLE **401** ON READER SERVICE CARD

In Short: CompuAdd's 386/16, 386/20, and 386/25 are low-cost 386s from a mail-order company known for packing quality components into inexpensive machines. Although the benchmark test results did not stand out, each machine is a respectable performer with a number of video and disk options. The in-house-engineered 386/20 and 386/25 are a big step in the right direction.

On the inside and outside, the 386/25 is identical to the 386/20, with the obvious exception that its components are rated at 25 MHz instead of 20 MHz. Our benchmark tests show that some of the fastest disk times were turned in by the unit's 320MB MiniScribe drive; the 386/25 also sports fast video.

As in the 386/20, a division of the processor clock (25 MHz divided by 2 or 3) is used to govern the bus speed. In this unit, the data bus runs at 8.3 or 12.5 MHz. CompuAdd should have gone the extra mile and included a separate, 16-MHz crystal on the motherboard to guarantee an 8-MHz bus speed.

CompuAdd's 386/16, 386/20, and 386/25 prove that you don't have to sacrifice performance and functionality when buying from mail-order companies. Nor do you have to take out a second mortgage when shopping for a 386.—**Greg Alwang**

COMPUTER PRODUCTS UNITED INC.
CPU 386/20
CPU 386/25

Great chefs never reveal their recipes, but the formula for a top-notch 386 is no secret. A fast processor, a static RAM cache, easy memory expansion, shadow RAM, and a compatible BIOS mixed in equal parts are the makings of a high-quality 386 machine.

Computer Products United, a California-based PC maker, has blended these requisite ingredients into its two competitively priced, first-rate 386s—the CPU 386/20, base-priced at $1,895, and the $2,295 CPU 386/25. The base system of each machine includes a Priam RLL controller, 1MB of RAM, a 1.2MB floppy disk drive, and one parallel, one game, and two serial ports.

CPU 386/20 Although you'd be hard-pressed to single out any one aspect of the CPU 386/20 that is extraordinary or truly unique, the system blends trusted components into a solid machine with reliable operation and better-than-average performance. On our benchmark tests, the system usually scored in the middle to high range of its class.

The CPU 386/20 wraps a 200-watt Astec power supply, a 5¼-inch, high-density floppy disk drive, and a conventional AT chassis around an American Megatrends AMI-386XT 20-MHz motherboard. Though the AMI motherboard would have fit into a smaller-footprint chassis, CPU chose to house it in a full AT-size case to allow space for up to four half-height disk drives. If desk room is a critical factor, you can order CPU's optional $200 tower case.

To help make an XT-sized mother-

Computer Products United sells 20- and 25-MHz system parts from brand-name companies like AMI and Priam. The CPU 386/25 is further noteworthy because of its motherboard's ability to accept 8MB worth of both DIP and SIMM RAM.

board possible, AMI relegated all RAM to a 32-bit memory board that resides in the motherboard's proprietary 32-bit expansion slot. You can add a second megabyte of 256-kilobit chips to the base 1MB of 256-kilobit chips or use 1-megabit chips to pack up to 8MB on the card. At the expense of the adjacent 8-bit expansion slot, an optional daughtercard adds another 8MB, upping the system total to 16MB.

American Megatrends was one of the first independent 80386 motherboard makers, pioneering memory caching and ROM remapping (now dubbed shadow RAM). The CPU 386/20's large 64K static RAM cache effectively caches all memory installed in the system. The widely used and therefore time-tested AMI BIOS is famed for its handy inclusion of easy-to-use and comprehensive versions of both setup and diagnostics utilities. One of the few features missing from this motherboard is support for a Weitek math coprocessor to supplement its Intel 80387 socket.

The tested CPU 386/20, priced at $4,575, included a rock-solid RLL Priam 70MB hard disk drive and controller, a soft-touch keyboard from Hi-Tek, a VGA video system, and 2MB RAM. With a computer this fast, you'll want to substitute a 16-bit VGA for the stock Video Seven 8-bit Vega VGA. That's easy enough, as Computer Products United is willing to arrange substitution of a variety of components for the system's standard issue; CPU offers eight different hard disk options alone. You can even substitute a less expensive, slower motherboard (sans 64K cache) for the fast AMI model.

CPU 386/25 If you were impressed by the CPU 386/20's value, you'll find the CPU 386/25 an absolutely stunning deal. For $2,455 more than the tested 20-MHz machine, the evaluated CPU 386/25 delivers the attributes of the lesser model plus a handful more, including comprehensive math coprocessor support for either an Intel 80387 or a Weitek 1167, a unique and flexible memory expansion scheme, an additional 2MB of RAM, and a 230MB Priam hard disk drive. Not only that, but our benchmark tests showcased the system's muscular performance, marking it a strong contender.

The CPU 386/25's larger chassis, with its five full drive bays, barely restrains the American Megatrends AMI-386AT Mark II 25-MHz motherboard within. Like the motherboard on its less speedy sibling, this one also accommodates 64K of cache memory. The board's speedy 80-nanosecond system memory occupies sockets that can house either 256-kilobit or 1-megabit chips in DIP packs. That makes a total of either 1- or 4MB of memory, respectively. Four SIMM strips, also on the motherboard, hold either 256-kilobit or 1-megabit memory modules, too. The full complement of both DIP and SIMM RAM totals a grand 8MB on the motherboard. If that'll do, you can use the 32-bit memory expansion slot, which normally holds a second 8MB, as a standard 8-bit slot.

Only if you're flush with cash or restricted to buying from one of the well-known makers like IBM or Compaq should you pass up considering the CPU 386s. Bargain prices usually bespeak trade-offs, but the CPU 386/20 is precisely the sum of its highly regarded, reliable components, and the CPU386/25 delivers everything you'd expect from a top-flight, top-of-the-line desktop PC.

—Steven Sagman

FACT FILE

Computer Products United Inc.
12803 Schabarum Ave.
Irwindale, CA 91706
(818) 338-5959
(800) 824-2936

CPU 386/20
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, $1,895; with 60MB hard disk, monochrome monitor, DOS 3.3, $2,720; with VGA monitor, $3,290; with 2MB RAM, 70MB hard disk, 80387-20 coprocessor, $4,575. 1MB RAM upgrade, $395; 60MB tape backup, $895.
CIRCLE **406** ON READER SERVICE CARD

CPU 386/25
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, $2,295; with 60MB hard disk, monochrome monitor, DOS 3.3, $3,120; with VGA monitor, $3,695; with 4MB RAM, 230MB hard disk, 80387-20 coprocessor, $7,030. 1MB RAM upgrade, $395; 60MB tape backup, $895.
CIRCLE **407** ON READER SERVICE CARD

In Short: Computer Products United has combined such features as cache memory, easy memory expansion, and shadow RAM in its two competitively priced, first-rate 386s. The CPU 386/20 performed well in testing; the CPU 386/25 is a strong contender in the 25-MHz pack.

COMPUTER SYSTEMS CORP.
LEO 386/16

Leo, the zodiacal sign, represents leadership, bravery, and dynamism. But when it comes to the demands of 386 performance, the Leo 386/16 from Computer Systems Corp. blends into, rather than leads, the competition.

For a reasonable base price of $2,499—which includes 2MB RAM, a 1.2MB floppy disk drive, two serial ports and one parallel port—the zero-wait-state tower system does merit some consideration. The addition of a 40MB Seagate Technology hard disk drive, VGA monitor, and 8-bit adapter for our test configuration brings the price to $3,825.

Open up the machine's sturdy case and you'll find a well-laid-out floor plan that starts with a motherboard designed by First International Computer, the Leo's Tai-

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CIRCLE 121 ON READER SERVICE CARD

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The Leo 386/16, from Computer Systems Corp., is an affordably priced, zero-wait-state tower system. The use of mostly standard components in a sturdy case is commendable, but the front-panel turbo and reset buttons look alike and are dangerously close to each other.

PC MAGAZINE FACT FILE

Leo 386/16
Computer Systems Corp.
229 West Grand Ave.
Bensenville, IL 60106
(312) 595-2950
(800) 284-7746
List Price: With 2MB RAM, 1.2MB 5¼-inch floppy disk drive, $2,499; with 80MB hard disk, monochrome monitor, DOS 3.3, $3,365; with VGA monitor, $4,125; with 40MB hard disk, $3,825. 150MB hard disk, $1,999; 60MB tape backup, $815.
In Short: The Leo 386/16 zero-wait-state tower system showed some promise in benchmark testing, but technical shortcomings and design quirks held it back from real competition with the rest of the pack.
CIRCLE **405** ON READER SERVICE CARD

wan-based manufacturer. The BIOS is the trustworthy Phoenix, albeit more than a year old; the chip set is TTL. If you're looking to cut costs at the expense of a little speed, the board will accept an 80287 math coprocessor as well as the 387.

The slotted 32-bit memory is made up of 256-kilobit DIP, 80-nanosecond DRAMs that can be upgraded in 2- to 6MB increments to a 16MB maximum. Shadow RAM helps to quicken BIOS routines, but there's the usual catch: the upper 384K of your first megabyte is unavailable for other purposes, such as virtual disks.

In addition to the expansion slot devoted to memory, the Leo features another 32-bit slot, plus four 16-bit and two 8-bit slots (six slots remain after installation of a disk controller and video card). The 220-watt power supply is made by Power Tronic, and four AA batteries retain setup information in CMOS memory when the system is off.

Outside the machine are three switches for power on/off, turbo mode (the alternate speed is 6 MHz), and reset, plus a key lock. Don't try a quick switch into turbo mode, though, or you might find you've just reset the machine; the turbo and reset buttons are dangerously close to each other and look almost identical. A lip hanging over the A: drive interferes with quick access to the drive door when open. And the wobbly Enhanced-style keyboard from BTC is not the most comfortable on your fingertips.

AVERAGE TEST RESULTS The Leo had a few moments in the limelight by scoring in the top third on PC Labs' Extended Memory and small-record DOS File Access benchmark tests. Middle-of-the-road results marked most of the testing, although the system failed to rise from the depths in the 80386 Instruction Mix and large-record DOS File Access tests.

Another problem occasionally presented itself upon boot-up when the CMOS-stored setup returned to its default configuration and subsequently would not recognize the hard disk. Out of about 20 boots, this occurred twice after switching one video card for another; once it needed no more prodding than removal of the cover with the unit turned off. A call to the vendor's technical support at Computer Outlet, the Chicago-based retail chain that actually sells the machine, yielded no satisfactory answers.

Computer Systems Corp. also sells a 20-MHz version of the same machine (not reviewed here); a 25-MHz unit, expected to ship this spring, will feature cache memory. We can't predict if the 25-MHz model will be powerful enough to win favor among serious users, but if the muscle of the 16-MHz model is any indication, the Leo is not the one to lead the charge.
—Ilona Price and Edward L. Perratore

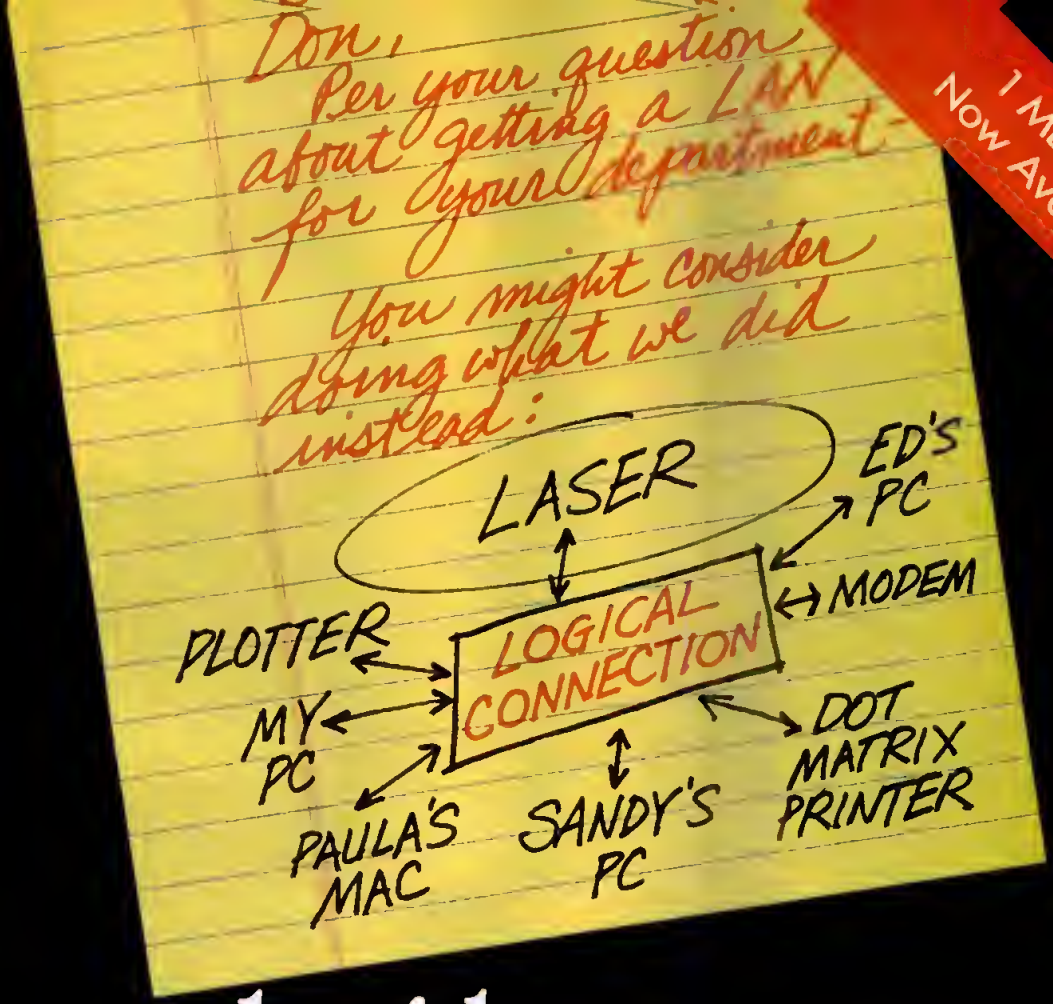
CONTINENTAL TECHNOLOGY INC.
TOP GUN 386/20
TOP GUN 386/25

There are so many vendors making 386 compatibles these days that it seems as if they pull their company names out of thin air. In fact, Continental Technology may have done just that, and like the airline, it has made rock-bottom prices its key theme. The base price of the company's Top Gun 386/20 is $1,750, and its 386/25 costs only $150 more.

Both machines are assembled from a reasonable storehouse of parts, and our test units worked first time, every time. Our benchmark tests showed that the 20-MHz Continental computer, at least, ran at a respectable speed for its class.

ORDINARY EXTERIOR The external trappings of the machines hold few surprises. Both come standard with roomy desktop AT-style cases sporting the obligatory reset and turbo switches on the front panel. Both also include a 1.2MB floppy disk drive. There are no hard disk drives built into the standard configurations, but the company sells seven different hard drives made by either Kyocera or Seagate Technology. We received a 150MB RLL-coded Seagate drive on the faster machine and a 65MB Seagate on the 20-MHz unit.

Serial and parallel ports are optional and vary in cost from $15 to $50, depending on the I/O configuration. For a mere $89, you get DOS 3.3 (albeit without doc-



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UNISYS

CIRCLE 296 ON READER SERVICE CARD

Continental Technology's Top Gun 386/25, as well as its 20-MHz counterpart, comes with a novelty item: a keyboard with a "fill-in-the-strip" function template for entering the key commands of a program, and a numeric keypad-cum-solar-calculator.

umentation) and GW-BASIC. The vendor also said that *Disk Manager* is included if you buy a hard disk drive, although we did not receive it.

The Focus 3001 keyboard from Focus Electronic Corp. is the machine's novelty item. Not only does it have a "fill-in-the-strip" function key template to let you enter the function key commands for your favorite program, but the numeric keypad transforms itself into a solar-powered calculator. In theory, the solar calculator takes over when the machine is powered down. In practice, our fluorescent-lit PC Labs rooms didn't have enough oomph to charge the solar cell.

The system's Phoenix BIOS includes options to toggle on shadow RAM and select zero or one wait state. The other system components, which included the CTX International monitor, Tecmar VGA display adapter, Seagate hard disk drive, and Mitsumi floppy disk drive, all worked well. The DTC controller card uses 1:1 interleaving and Run Length Limited (RLL) coding (MFM—for Modified Frequency Modulation—is optional) for optimal speed. Also, the 230-watt Enhance power supply is a nice change compared with the 200-watt PC power supplies.

CLUES TO LOW PRICE The Unitron/CTX motherboard appears to be well designed and installed; it hosts one proprietary 32-bit slot, four 16-bit slots, and three 8-bit slots. The motherboard also offers one clue as to why the price of at least the 25-MHz machine is so low. The CPU is an Intel Corp. 80386 20-MHz unit running above its rated speed. The benchmark tests are unaffected by allowing the slower processor to run at 25 MHz, but those who worry about reliability will remember that Intel guarantees its chips only when they are operated within the speed limit.

Another unusual feature on the motherboard is the use of space-saving DRAM-module SIP memory. Each machine comes standard with 1MB of SIP, expandable to 8MB on the motherboard. The 386/25 came configured with a heavy-duty 8MB on-board, configured as an SIP module of 9 by 1 megabit; our 386/20 had 2MB—configured as an SIP module of 9 by 256 kilobits soldered onto the motherboard. In the latter machine, the SIP was stacked in four tall banks, creating a wobbling module and making it tricky to install full-length add-on boards in places where the SIP modules rose from the motherboard. The SIP modules used soldering rather than socketing.

While neither machine gave us any problems, talking to the vendor made us wonder about the possibility of receiving the same system components twice in a row. The company appears to sell you what's available on a particular day; during the course of our review, components changed: the 16-MHz CPU that was originally on the 386/20 was replaced with a 20-MHz version, and we wound up with different keyboards and monitors from those we started out with. The company also will negotiate prices with its customers. The bottom line? If you don't mind the flea market approach when purchasing a 386, you should do all right.

—Robin Raskin

PC MAGAZINE FACT FILE

Continental Technology Inc.
300 McGaw Dr.
Edison, NJ 08837
(800) 872-2841
(201) 225-8899

Top Gun 386/20
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, $1,750; with 60MB hard disk, monochrome monitor, DOS 3.3, $2,350; with VGA monitor, $2,889; with 2MB RAM, $3,314. 1MB RAM upgrade, $440; 80MB hard disk, $720; 60MB tape backup, $530.

CIRCLE 402 ON READER SERVICE CARD

Top Gun 386/25
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, $1,900; with 60MB hard disk, monochrome monitor, DOS 3.3, $2,650; with VGA monitor, $3,199; with 8MB RAM, 120MB hard disk, $7,253. 1MB RAM upgrade, $480; 60MB tape backup, $530.

CIRCLE 403 ON READER SERVICE CARD

In Short: The Continental Top Gun 386/20 and 386/25 are 386-powered AT clones that perform respectably for rock-bottom prices. Based on their parent company's CTX motherboard, the systems offer a wide range of accessories and upgrades and are expandable to 8MB of memory on the motherboard. Note that the 386/25 uses a 20-MHz processor.

CORDATA TECHNOLOGIES INC.
CORDATA CS 5000
CORDATA CS 5000-2

It's hard to make a 386 desktop PC that stands out in its class these days. Nearly everyone uses the same clone cases, the same keyboards, and sometimes even the same manuals. Not only that, but the actual system architecture of one company's product will more than likely resemble that of units from a hundred other manufacturers. But not so with the 16-MHz Cordata CS 5000 (base-priced at $3,195) and the 20-MHz CS 5000-2 ($3,995).

The most obvious difference between other clones and the Cordata models is the case. It is only about an 1½ inches narrower than a standard AT, but the front-panel styling helps it appear a little smaller. Two half-height drive bay openings show from the front, along with knockout panels for access to an additional two half-height bays. The front panel also sports a key lock, a hardware reset switch, and a three-digit display that shows CPU speed and

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CIRCLE 111 ON READER SERVICE CARD

The Cordata CS 5000-2, like the CS 5000, is unusually constructed: expansion slots sit beneath an aluminum cover that cuts down radio emissions, and RAM chips are under the right-hand disk bay. Both are difficult to access.

various diagnostic messages.

The real differences become apparent when you take the cover off of each machine. The cover itself is just a U-shaped panel that reaches halfway down the sides; when removed, the front and rear panels remain behind. Inside, you'll discover a sheet-metal box on the left, disk drives at the right front, and a power supply in back of the drive bays.

No expansion slots are visible; that's because they're resting beneath an aluminum cover (similar to one in the Sanyo MBC-18 Plus) meant to reduce radio-frequency emissions. From an engineering viewpoint, it looks like a nice feature. For the end user, it looks like a mistake. In order to take off this covering, you have to remove a screw deep inside the case; unfortunately, this screw also happens to hold down one end of the computer's speaker.

With the card-cage cover removed, you find six slots: one 8-bit and five 16-bit. This may seem unduly restrictive, but it's really not so bad. The computer comes with one parallel and two serial ports on the Cordata motherboard, as well as a floppy disk drive controller, so you need not give up slot space for these components. The motherboard also contains the CPU and up to 16MB of 32-bit RAM—no need to give up slot space there, either. The test machines also came with a special card that combined both a hard disk controller and a VGA adapter, thereby taking up only one of the six slots.

HIDE-AND-SEEK The case layout has one more hidden drawback—literally hidden. The memory chips are secreted under the right-hand disk bay, and the only way to gain access to them is to take off the bottom half of the case and remove the motherboard. It's like having to pull off a car's front tire so you can change the oil. Suffice to say this is not an exercise that you would undertake casually.

The computers rely on Cordata's version of a Phoenix ROM BIOS, which includes a nice configuration setup program accessed with a Ctrl-Alt-S keystroke combination. The program is unusual in that it offers the advanced Chips and Technologies CHIPSet Feature Control utilities, which allow you to adjust wait states, BIOS shadowing, memory mapping, and even the precharge timing for the memory. These are handy features for making adjustments for different-speed chips and for tuning performance to optimal levels.

The 16- and 20-MHz test systems, list priced at $5,734 and $7,034, respectively, came equipped with 2MB RAM, a 1.2MB floppy disk drive, and a VGA monitor/card combination. A 40MB hard disk was included in the Cordata CS 5000, while its speedier sibling sported an 80MB hard disk. Both machines performed as expected for their class, roughly in the middle of the pack in most benchmark tests.

On the plus side, the case does offer some nice design features, and it has ample space and power to handle full-blown configurations. But given the difficulties involved in working on the insides of these machines, they are probably best suited for people who will put them in one place and leave them alone. Do not pick these systems if you frequently install different cards or change memory configurations.

In addition, the list prices for these two models are well above those of many good low-end machines. Given the quirky architecture and average performance, the Cordatas do not represent a compelling value.—**Alfred Poor**

PC MAGAZINE FACT FILE

Cordata Technologies Inc.
1055 W. Victoria St.
Compton, CA 90220
(800) 621-6746
(800) 331-5867 (in Calif.)

Cordata CS 5000
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, DOS 3.3, $3,195; with 2MB RAM, 40MB hard disk, VGA monochrome monitor, $5,224; with VGA monitor, $5,734; with 80MB hard disk, $6,234. 1MB RAM upgrade, $695.

CIRCLE 616 ON READER SERVICE CARD

Cordata CS 5000-2
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, DOS 3.3, $3,995; with 2MB RAM, 40MB hard disk, VGA monochrome monitor, $6,024; with VGA monitor, $6,534; with 80MB hard disk, $7,034. 1MB RAM upgrade, $695.

CIRCLE 617 ON READER SERVICE CARD

In Short: Some nice design features are sandwiched in with some quirky architecture, making these systems best for users who will put them in one place and leave them alone, without trying to install cards often or change memory configurations. List prices are high; performance is average.

CORE INTERNATIONAL
CORE ATOMIZER 386/20
CORE ATOMIZER 386/25

If you break them down into their constituent parts, you'll find many common components in Core International's two systems. That's where the similarity ends. The base configuration of the small-footprint ATomizer 386/20—1MB RAM, serial and parallel ports, floppy/hard disk controller, and keyboard—costs a reasonable $2,995. But if you need room for gigabytes of storage, the basic setup of the 25-MHz tower model, with 1MB RAM and a 1.2MB 5¼-inch floppy disk drive, may seem reasonable at $6,495.

The motherboards in both review machines came populated with a 1988 American Megatrends BIOS, Chips and Tech-

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CIRCLE 527 ON READER SERVICE CARD

nologies chip sets, 25-nanosecond 96K caches, and 1MB of RAM (4MB for the 386/25), of which 384K is used to shadow the BIOS and video RAM.

An Everex Magic I/O serial and parallel port card, an 8-bit Paradise VGA card, and a Core ESDI RLL drive controller occupied three slots in the test unit. A 32-bit slot in each machine accepts a proprietary memory card that holds up to 8MB (32MB when 4MB chips become available).

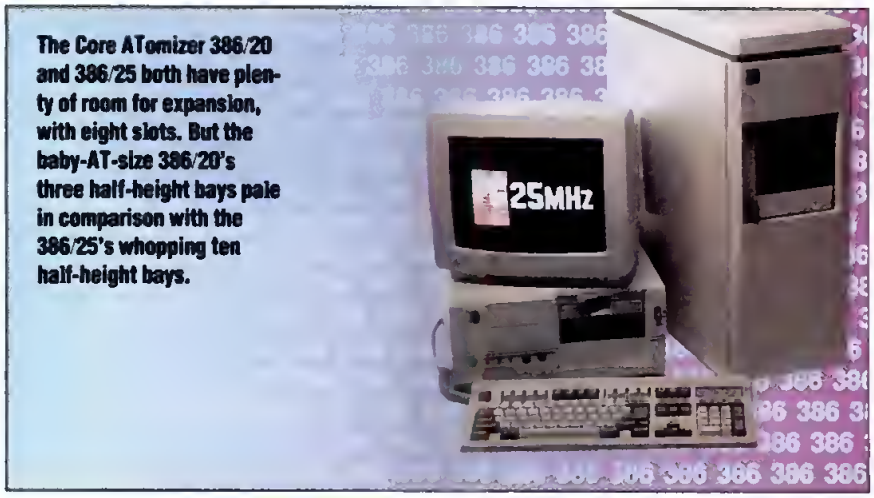
Focus Electronics' mechanical Enhanced-style keyboard, a 1.2MB floppy disk drive, a Core hard disk, and a Mitsubishi VGA display completed each system. And Core throws in DOS 3.3, its own setup and diagnostic software, and *386Limit*, a version of Qualitas's *386-to-the-Max* expanded memory manager.

ATOMIZER 386/20 Core calls the ATomizer 386/20 its "baby AT," and at 14½ by 15¾ by 7 (HWD) inches, the appellation is certainly appropriate. The price is relatively small, too: $4,383 will buy the base configuration plus a high-density floppy disk drive of either size, a VGA card and display, and a 70MB Core hard disk drive. Our $5,872 test configuration used 80-ns. static-column RAM SIMMs on the motherboard, a 90MB Core HC-90 hard disk drive rated at 16 milliseconds, and an 80387 coprocessor.

But expandability doesn't suffer at the expense of this baby's size. Though there's room for only three half-height drive bays, the machine boasts the same eight expansion slots found in its full-size brethren—six 16-bit, one 8-bit, and one 32-bit. The controller cables, however, obstruct a 16-bit card from fitting properly in the innermost 16-bit slot.

Power, reset, and turbo buttons adorn the front panel of the 386/20. The turbo button won't change your clock speed; you'll have to switch between 8 and 20 MHz using the keyboard. Unfortunately, a timing problem with the 10-MHz Core CNT-HCR controller renders the hard drive drive unreadable at 8 MHz—a problem the company claims to have corrected even as I write this.

ATOMIZER 386/25 Intended to house many megabytes, the ATomizer 386/25 sports a whopping ten half-height drive bays, three of which are exposed. If you need frequent access to more than three bays, you can leave the machine's front panel open. Four knockouts for any size I/O port augment the machine's capacity.



The Core ATomizer 386/20 and 386/25 both have plenty of room for expansion, with eight slots. But the baby-AT-size 386/20's three half-height bays pale in comparison with the 386/25's whopping ten half-height bays.

A setup consisting of the base configuration plus a 70MB Core hard disk, VGA card, and VGA monochrome monitor costs $8,093. The 4MB of memory on the motherboard of our $15,000 evaluation unit consisted of 80-ns. 256-kilobit DRAM DIPs; an additional 4MB of SIMMs can bring the total to 8MB on the motherboard. A 15-MHz Core CNT-ATP controlled the 17-ms. 650MB Core drive and the 1.2MB floppy disk drive.

Variable-speed dual fans in the 386/25 operate very quietly, working hardest at boot time, when they're needed most. Amenities include power, reset, and a similarly impotent turbo button on the front.

The keyboard feels comfortably clicky and comes with a flip-down plastic dust cover—a mild but easily removable nuisance. More disturbingly, the keyboard on the 386/25 sometimes locked up the system when bounced on my well-padded lap, and a Ctrl key on the 386/20 ceased to function after only a few minutes of use.

Core will configure its machines almost any way you want. Since the firm specializes in hard disk drives, it's not surprising that Core offers 34 combinations of hard drives ranging in size from 40MB to 1.3 gigabytes. A standard warranty covers 1 year's worth of problems with the system and 3 years' worth for the hard disk.

Both machines performed adequately in the benchmark tests. But while neither one of these ATomizers blows away the competition, they are well-built performers backed by an accommodating company.—**Lori Grunin**

PC MAGAZINE FACT FILE

Core International
6500 East Rogers Circle
Boca Raton, FL 33487
(407) 997-6044

Core ATomizer 386/20
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, $2,995; with 70MB hard disk, VGA monochrome monitor, DOS 3.3, $4,200; with VGA monitor, $4,383; with 90MB hard disk, 80387 coprocessor, $5,872. 1MB RAM upgrade, $500; 150MB hard disk, $2,796; 60MB tape backup, $1,036.

CIRCLE 001 ON READER SERVICE CARD

Core ATomizer 386/25
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, $6,495; with 70MB hard disk, VGA monochrome monitor, DOS 3.3, $8,093; with VGA monitor, $8,276; with 4MB RAM, 650MB hard disk, $15,000. 1MB RAM upgrade, $500; 60MB tape backup, $1,036.

CIRCLE 002 ON READER SERVICE CARD

In Short: The small-footprint ATomizer 386/20 is a competitively priced, solidly constructed machine for those with modest expansion needs; the ATomizer 386/25 is a pricier but roomier and equally well performing system.

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-Personal Computing's 10 Best Mail Order Companies , Feb. 1989

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CIRCLE 303 ON READER SERVICE CARD

PC BRAND 286/12 $949

12 MHz Clock, Zero Wait Operation,
Norton SI 15.3 •Landmark™ Speed 16MHz
512K, 1.2MB or 1.44MB Drive, 101- Keyboard

Standard System Features:

- 80286 Processor Operating at 12MHz with Zero Wait States delivering 16MHz Effective Throughput
- 512K RAM expandable to 4MB on the System board using 256K and/or 1MB 100ns RAM chips
- 1.2MB 5.25" or 1.44MB 3.5" Diskette Drive
- 1:1 Interleaving Dual Hard Drive/Floppy Drive Controller
- Enhanced 101-key AT Style Keyboard
- High Capacity System Power supply
- Real Time Clock/Calendar with 5 Year Battery
- 80287 Co-Processor Support
- Phoenix BIOS with full MS/DOS, OS/2, XENIX, NOVELL, 3COM and PCNET compatibility
- Built-in System Board LIM EMS hardware drivers
- User configurable I/O timing permitting compatible operation with older peripherals or faster I/O for newer devices
- 8 Slot motherboard design (6 16Bit & 2 8Bit)
- Small foot print case with 5 Disk Drive bays

Options:

- Full size 5 drive case • Factory Installed RAM Upgrades
- Custom configurations w/Name Brand peripherals of your choice
- Compaq® Style LCD Portable • Tower Case

Standard Pre-Built Configurations:

286/12 With 512K, Hard Disk Drive, Monitor & Video Card				
Drives / Video	20Mb 1:1 MFM	40MB-40MS 1:1 MFM	40MB-25MS 1:1 MFM	71MB-18MS 1:1 MFM
Mono	$1335	$1439	$1548	$1679
EGA	$1729	$1833	$1942	$2073
VGA	$1900	$2004	$2113	$2244

PC BRAND 286/20 $1099

Ideal Novell Server!

20 MHz Clock, Zero Wait Operation
Norton SI 20.4 •Landmark™ Speed 25.9MHz
512K, 1.2MB or 1.44MB Drive, 101-Keyboard

Standard System Features:

- 80286 Processor Operating at 20MHz with Zero Wait 5tates in interleave mode delivering 26MHz Effective Throughput
- 512K RAM expandable to 8MB on the System board using 256K and/or 1MB 100ns RAM chipa (4MB on motherboard and 4MB on optional apecial interleaving daughter card)
- 1.2MB 5.25" or 1.44MB 3.5" Diskette Drive
- 1:1 Interleaving Dual Hard Drive/Floppy Drive controller
- Enhanced 101-key AT Style Keyboard
- High Capacity 200 Watt System Power Supply
- Real Time Clock/Calendar with 5 Year Battery
- 80287 Co-Processor Support
- Phoenix BIOS with full MS/DOS, OS/2, XENIX, NOVELL, 3COM, and PCNET compatibility
- Built-in System Board LIM 4.0 EMS hardware drivers
- User configurable I/O timing permitting compatible operation with older peripherals or faster I/O for newer devices
- 8 Slot motherboard design (6 16Bit & 2 8Bit)
- Medium foot print case with 5 Disk Drive bays

Options:

- 386SX Upgrade • Tower Case • 4MB Interleaving Ram Card
- Custom configurations w/Name Brand peripherals of your choice
- Compaq® Style LCD Portable • Factory Installed RAM Upgrades

Standard Pre-Built Configurations:

286/20 With 512K, Hard Disk Drive, Monitor & Video Card						
Drives / Video	40MB-40MS 1:1 MFM	40MB-25MS 1:1 MFM	71MB-18MS 1:1 MFM	110MB-28MS 1:1 RLL	150-16MS 1:1 ESDI	320-16MS 1:1 E6DI
Mono	$1590	$1699	$1830	$2096	$2800	$3523
EGA	$1984	$2093	$2224	$2490	$3250	$3917
VGA	$2155	$2264	$2395	$2661	$3500	$4088

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- Set-up & Operating instructions.

Standard Pre-Built Configurations:

PCV20 AD-II With 512K, Hard Disk Drive, Monitor & Video Card					
Video \ Drive	1 Floppy	2 Floppy	20MB	30MB	40MB
Mono	$669	$740	$924	$950	$1077
RGB	$839	$914	$1098	$1124	$1241
EGA	$1059	$1134	$1318	$1344	$1461

PC BRAND 386/20 $1995

20 MHz Clock, Zero Wait Operation

Norton SI 24 • Landmark Speed 30MHz

1024K, 1.2MB or 1.44MB Drive, 101-Keyboard

Standard System Features:

- Intel 80386 Processor Operating at 20MHz with Zero Wait States in interleave mode delivering 30MHz Effective Throughput
- 1024K RAM standard expandable to 16MB via 32Bit RAM boards using 256K and/or 1MB 100ns RAM chips
- 1.2MB 5.25" or 1.44MB 3.5" Diskette Drive
- 1:1 Interleaving Dual Hard Drive/Floppy Drive controller
- Enhanced 101-key AT Style Keyboard
- High Capacity 200 Watt System Power Supply
- Real Time Clock/Calendar with 5 Year Battery
- 80287 or 80387 Co-Processor Support
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- User configurable I/O timing permitting compatible operation with older peripherals or faster I/O for newer devices
- 8 Slot motherboard design (6 16Bit & 2 8Bit & 2 32Bit)
- Medium foot print case with 5 Disk Drive bays

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- Custom configurations w/Name Brand peripherals of your choice
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Standard Pre-Built Configuration:

386/20 With 1024K, Hard Disk Drive, Monitor & Video Card						
Drives / Video	40MB-40MS 1:1 MFM	40MB-25MS 1:1 MFM	71MB-18MS 1:1 MFM	110-28MS 1:1RLL	150-16MS 1:1ESDI	320-16MS 1:1ESDI
Mono	$2540	$2649	$2780	$3046	$3750	$4473
EGA	$2934	$3043	$3174	$3440	$4250	$4867
VGA	$3105	$3214	$3345	$3611	$4400	$5038

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CIRCLE 309 ON READER SERVICE CARD

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-PC Magazine's Editors Choice Feb.14, 1989

"Faster Than a Speeding Bullet!"
-Computer Shopper Cover Story Nov, 1988

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Norton SI 28.3 • Landmark Speed 35MHz
Norton SI 30.5 • Landmark Speed 43.5 w/Cache
1024K, 1.2MB or 1.44MB Drive, 101-Keyboard

Standard System Features:

- Intel 80386 Processor Operating at 25MHz with Zero Wait States in Interleave mode delivering 35MHz Effective Throughput
- 1024K RAM standard expandable to 16MB via 32Bit RAM boards using 256K and/or 1MB RAM chips
- 1.2MB 5.25" or 1.44MB 3.5" Diskette Drive
- 1:1 Interleaving Dual Hard Drive/Floppy Drive controller
- Enhanced 101-key AT Style Keyboard
- High Capacity 200 Watt System Power Supply
- Real Time Clock/Calendar with 5 Year Battery
- 80287 or 80387 Co-Processor Support
- Phoenix BIOS with full MS/DOS, OS/2, XENIX, NOVELL, 3COM and PCNET compatibility
- User configurable I/O timing permitting compatible operation with older peripherals or faster I/O for newer devices
- 8 Slot motherboard design (6 16Bit & 2 8Bit & 2 32Bit)
- Medium foot print case with 5 Disk Drive bays

Options:

- 32/64KB Cache Processor • Weitek Coprocessor • Tower Case
- Custom configurations w/Name Brand peripherals of your choice
- Compaq® Style LCD Portable • 8MB 32Bit RAM Card

Standard Pre-Built Configurations:

386/25 With Hard Disk Drive, Monitor & Video Card

Drives / Video	40MB-40MS 1:1 MFM	40MB-25MS 1:1 MFM	71MB-19MS 1:1 MFM	110MB-28MS 1:1RLL	150-16MS 1:1ESDI	320-16MS 1:1ESDI
Mono	$2940	$3049	$3180	$3446	$4200	$4873
EGA	$3334	$3443	$3574	$3840	$4600	$5267
VGA	$3505	$3614	$3745	$4011	$4800	$5438

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Multiview 15" Full Page Monitor w/adapt... 890
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CM1430 14" (1024x768) Multifreq $595
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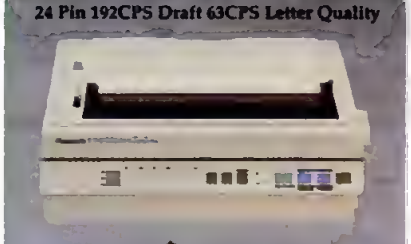

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CIRCLE 311 ON READER SERVICE CARD

DATAWORLD INC.
DATAWORLD DATA 386-16
DATAWORLD DATA 386-20
DATAWORLD DATA 386-25

DataWorld has unleashed three disparate computers upon the 386 market: the DataWorld Data 386-16, aimed at the person seeking an entry-level 386 in a standard desktop unit; the DataWorld Data 386-20 minitower, for anyone who wants power in a small package; and the DataWorld Data 386-25, designed for those who require sheer power and expandability.

DataWorld prices its systems at the lower end of the spectrum: the 16-, 20-, and 25-MHz base units each come with 1MB RAM, 1.2MB floppy disk drive, ST-506 drive controller, parallel port, monochrome monitor, and Hercules-compatible card, for $1,995; $2,695; and $3,695, respectively. A hardware reset switch, turbo light, and disk access light are also standard; all you need is a hard disk drive to complete each system.

The DataWorld Enhanced-style keyboard that comes with each computer includes a built-in dust cover that conveniently doubles as a data stand when flipped up. A mechanical click is sounded as each key is depressed; when typing rapidly, the noisy keyboard chatter may take some getting used to. An extra $10 gets you the same keyboard with the *WordPerfect* command set printed on the function keys.

DATA 386-16 Even with additional options, the DataWorld machines are priced right. The 386-16 test unit had 2MB of RAM, a 44MB MiniScribe drive, one parallel and two serial ports, a Tatung VGA monitor, a 16-bit Paradise VGA, and DOS 3.3, all for $3,853.

The AT-sized system offers the usual five half-height drive bays, with three accessible from the front. Its 230-watt power supply (found on the 25-MHz unit as well) includes four device connectors.

A Micronics motherboard featuring the Phoenix BIOS Plus is used. The BIOS has a convenient ROM-based setup accessed at any time with the Ctrl-Alt-Esc keys.

No memory fits on the motherboard. Instead, the standard 32-bit memory card has space for 2MB of RAM in 256-kilobit chips; a daughtercard can bring the total to 8MB. System memory can be upped to 16MB through a special memory card that accepts 8MB of 1-megabit chips and a daughtercard that adds 8MB more. If the Data 386-16 is used as a network server, multiuser system, or in any other situation where memory requirements may grow substantially, you'll be wise to order the board that uses 1-megabit chips.

DATA 386-20 The Data 386-20 shipped to PC Labs was a stylish minitower, measuring 13¼ by 7 by 16 inches. It has a power switch and keyboard connector on the front, making it just as convenient to place beneath your desk as on top of it.

The Data 386-20 evaluation unit we received came with the same display and VGA card as the 16-MHz system, as well as 2MB of RAM, a 66MB RLL Toshiba hard disk, a Data Technology RLL controller, one parallel and two serial ports, and DOS 3.3 for a reasonable $4,653.

This computer also packs five half-height drive bays. The space-saving 200-watt power supply has only three device connectors, so you'll have to choose your internal drives wisely.

The system contains an XT-sized AMI motherboard with the AMI 386 BIOS and a 64K direct-mapped memory cache using 25-nanosecond SRAM. ROM-based setup and diagnostics accompany the AMI BIOS, so you won't have to play with diskettes to change your configuration. A 32-bit card accepts up to 16MB in DIP packs.

If you've got touchy software that needs to run at slower speeds, a key combination disables the cache, forcing the machine to run at one wait state, and can set the processor speed to 8 MHz. The turbo switches on the front of both the 20- and 25-MHz units are just for looks, but the turbo lights correctly display whether the processor is running at slow or normal speed.

Even with the cost of additional options, the Dataworld 386 machines are priced right.

DATA 386-25 The floor-standing Data 386-25 is a hefty number, weighing 47

The DataWorld Data 386-16 desktop machine and the Data 386-20 minitower include the usual five half-height bays. The Data 386-25 tower has plenty of room for expansion, with six accessible half-height bays and five expansion slots left over after adding in memory, controller, video, and I/O cards.

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FACT FILE

DataWorld Inc.
3733 San Gabriel River Pkwy.
Pico Rivera, CA 90660-1495
(800) 722-7702
(213) 695-3777

DataWorld Data 386-16
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, monochrome monitor, $1,995; with 66MB hard disk, monochrome monitor, DOS 3.3, $2,593; with VGA monitor, $3,193; with 2MB RAM, 44MB hard disk, $3,553. 1MB RAM upgrade, $360; 150MB hard disk, $1,665; 40MB tape backup, $319.
CIRCLE 422 ON READER SERVICE CARD

EDITOR'S CHOICE

DataWorld Data 386-20
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, monochrome monitor, $2,695; with 66MB hard disk, monochrome monitor, DOS 3.3, $3,393; with VGA monitor, $3,893; with 2MB RAM, $4,393. 1MB RAM upgrade, $500; 150MB hard disk, $1,665; 40MB tape backup, $319.
CIRCLE 423 ON READER SERVICE CARD

EDITOR'S CHOICE

DataWorld Data 386-25
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, monochrome monitor, $3,695; with 66MB hard disk, monochrome monitor, DOS 3.3, $4,293; with VGA monitor, $4,893; with 4MB RAM, 150MB hard disk, $7,594. 1MB RAM upgrade, $500.
CIRCLE 424 ON READER SERVICE CARD

In Short: The DataWorld desktop Data 386-16, Data 386-20 minitower, and Data 386 full-sized tower are all good values and first-rate performers from an up-and-coming mail-order firm. The 20-MHz minitower is an instant eye-catcher, offering functionality and expandability in a scaled-down, ergonomic case.

pounds and measuring 25¼ by 7½ by 17½ inches. With six accessible half-height drive bays, it has room for at least two full-height drives.

The system uses the AMI 386 BIOS and 64K memory cache on a full-sized AMI motherboard, which can accommodate 8MB of memory. Another 8MB can be added using a 32-bit memory card. The Data 386-25 tower offers an advantage by accepting both DIP- and SIMM-packed memory on the motherboard.

Like the Data 386-20, the Data 386-25 lets you disable the cache and reset the processor speed to 8 MHz to make use of cranky software.

In the large-sized 386-25, five expansion slots were still available after adding in a memory card, drive controller, and video and I/O cards. That's one more slot than is available to you after adding the same components to the DataWorld 16- and 20-MHz models. You can also plug an internal modem, network card, and fax board into the 386-25, and you'll still have two slots free.

The fully configured Data 386-25 sent to PC Labs was one of the least expensive 25-MHz units in this bunch. It came with 4MB of 80-ns. SIMMs, a 150MB Micropolis ESDI drive, a Data Technology ESDI controller, a Video Seven V-RAM 16-bit VGA card, a NEC MultiSync Plus monitor, and DOS 3.3 for only $7,594.

Our benchmark tests showed that the 25-MHz and 20-MHz units were generally solid performers, pulling in above-average scores. The 16-MHz system was somewhat slower, coming in at the low end of the midrange scores.

DataWorld includes the DCACHE disk-caching program (distributed by PC MagNet) and the host portion of Dynamic Microprocessor Associates' *pcAnywhere III* with each Data 386. The *pcAnywhere III* software is part of DataWorld's Remote Diagnostics Service. With *pcAnywhere* loaded on a customer's machine, a DataWorld technician can call and remotely diagnose or solve a problem. This remote service is in addition to the 1-year parts and labor warranty that comes with each machine. On-site service is also available at extra cost.

Each Data 386 comes with a short, illustrated manual that outlines setting up your PC, installing hardware options, and using *pcAnywhere*. Novice users will appreciate the 30-minute video that covers setup, hard disk management, and basic DOS commands.

The DataWorld machines have something for just about every 386 shopper. Whether you're looking for low prices, entry-level 386 computing, compact styling, or no-holds-barred expansion, one of these machines will suit your needs.

—Greg Alwang

DELL COMPUTER CORP.
DELL SYSTEM 310
DELL SYSTEM 325

Dell Computer Corp. is one mail-order firm that has been able to stand toe-to-toe with the big guys by offering quality computer systems and excellent support at reasonable prices. Its two 386 machines, the 20-MHz System 310 (base-priced at $2,799) and the 25-MHz System 325 ($4,599) reinforce Dell's commitment to compete at the high end of the PC market.

The machines, which can run at full processor speed or 8 or 4.77 MHz, resemble the original AT in appearance only. The front consists of three accessible drive bays on the right, with the power-on, disk activity indicators, and the system key lock on the left. Two of the drive bays on both evaluation units were filled with high-capacity floppy disk drives: one 5¼- and one 3½-inch. On the back are connectors for the space-saving parallel and serial ports built into the motherboard.

TESTED MODELS The units sent to PC Labs came with Dell's VGA Color Plus monitor and Video Seven VGA card. Both Dells also had the sturdy Key Tronic

Like the 20-MHz Dell System 310, the System 325 comes with Dell's VGA Color Plus monitor, a winner with a crisp display. The systems operate with less than one wait state, but were faster than many zero-wait-state units.

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For more information on our other 33 MHz systems just turn the page.

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CIRCLE 241 ON READER SERVICE CARD

101 keyboard, a delight to use as long as you don't mind having the function keys across the top. The evaluation 310, equipped with a 90MB Magnetic Peripherals hard disk drive and 4MB of RAM, goes for $6,229. With an equal amount of RAM and a 322MB Micropolis hard disk drive, the evaluated 25-MHz machine came to $9,130.

The Dell motherboard (OEMed from MicroWave) is garnished with the Chips and Technologies chip set and four sets of SIMM banks capable of handling 256-kilobit or 1-megabit SIMM packs. Although the SIMM and coprocessor sockets are easily accessible, the Intel 80386 and 82385 chips are buried underneath the left-hand drive bay. This is a problem only if you need to change them.

The systems use the Phoenix ROM BIOS Plus (Version 1.10 09 on the System 310 and Version 1.10 X48 on the System 325); this contains a ROM-based setup program which is accessed with the Ctrl-Alt-Ent key combination. Using the setup program, you can easily enable or disable the system and video BIOS shadowing.

Using 1-megabit DRAMs, the systems can hold 8MB on the motherboard for memory-intensive applications. If 8MB isn't enough, a proprietary 32-bit expansion card allows either unit to hold up to 16MB.

Dell uses both the page-mode and interleaving functions of the Chips and Technologies chip set as well as the cache controller (with 32K of static RAM) to speed up memory access. The company claims that the processors operate at "less than one" wait states, but our tests showed that the Dell machines are faster than many other 386s boasting zero wait states. The System 310 performed favorably on all the benchmark tests, indicating no weak or sluggish components. And the System 325's extremely fast conventional and extended memory times simply left other 25-MHz machines in the dust.

EXPANSION SLOTS Of the eight expansion slots (two 8-bit, six 16-bit) in each unit, two were given up to the Western Digital controller and the 16-bit video card. The 32-bit connector for the memory expansion card is located at the end of one of the 8-bit slots, making that slot good for only half-length cards. And if you're concerned about putting sensitive network cards into either Dell 386, never fear: the motherboard includes a separate 16-MHz crystal to maintain a constant 8-MHz bus speed.

Included with the systems is the Dell *System Analyzer*, a colorful diagnostics program with a menu-driven interface for testing memory, video adapter and monitor, keyboard, CMOS memory, DMA registers, hard disk drives, and parallel and serial ports. DOS can be ordered separately; with it, you also get the *PC-Kwik PowerPak* software with disk caching and the cursor speedup program *Cruise Control*.

Dell also offers a full year of free on-site service, but the machines we tested are of such high quality that repair visits should be rare. This emphasis on customer service, combined with the speed, expandability, dependability, and competitive pricing, makes it hard not to like these two machines.—**Greg Alwang**

FACT FILE

Dell Computer Corp.
9505 Arboretum Blvd.
Austin, TX 78759-7299
(512) 338-4400
(800) 426-5150

EDITOR'S CHOICE

Dell System 310
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, $2,799; with 40MB hard disk, monochrome monitor, DOS 3.3, $3,799; with VGA monitor, $4,299; with 4MB RAM, 90MB hard disk, 1.2MB 5¼-inch and 1.44MB 3½-inch floppy disk drives, $6,229. 1MB RAM upgrade, $480; 150MB hard disk, $1,699; 40MB tape backup, $349.95

CIRCLE 420 ON READER SERVICE CARD

Dell System 325
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, $4,599; with 90MB hard disk, monochrome monitor, DOS 3.3, $6,100; with VGA monitor, $6,400; with 4MB RAM, 322MB hard disk, 1.2MB 5¼-inch and 1.44MB 3½-inch floppy disk drives, $9,130. 4MB RAM upgrade, $2,199; 40MB tape backup, $349.95.

CIRCLE 421 ON READER SERVICE CARD

In Short: Dell maintains its reputation as a company with a competitive edge with these two high-end 386 PCs, which outperform and underprice the big-name competition. Filled with superb components and backed by a year of free on-site service, these two 386s are hard not to like.

DESTINY COMPUTERS

DESTINY 386-16
DESTINY 386-20
DESTINY 386-25

Destiny Computers' 386s are available to the general public through dealerships only. The company prides itself on putting together its 386 product line—the Destiny 386-16, Destiny 386-20, and Destiny 386-25—with brand-name components in just about any configuration a dealer requests.

Fittingly, Destiny offers various video components, 16 hard disk options, 7 different keyboards, 7 case types, a Phoenix or Award BIOS, and controllers from several manufacturers. The 16-, 20-, and 25-MHz test configurations, priced at $5,225, $5,870, and $7,000, respectively, are only a sampling of what the company can provide.

The three machines we looked at had a few features in common, including a Copal 1.2MB floppy disk drive. All used the Adaptek ACB-2322 ESDI controller, which can handle up to two floppy and two hard disk drives. They also included one of the two Wren III hard disk drives manufactured by Control Data Corp. The 386-16 and 386-20 had a 106MB unit, while the 386-25 came with a 182MB model.

A Trikor 102-key XT/AT switchable keyboard with a 9-foot cable was also supplied with each machine. While this keyboard has great audio feedback, it's too light and feels as if it could break easily.

All systems also come with a utility disk that lets you slow the processor to 6 or 8 MHz, increase the number of wait states from zero to one, and set up extended and expanded (LIM 4.0) memory.

While all three computers were engineered around Micronics motherboards, each system used a different model. The three boards have common characteristics, however, including an empty socket for the 80387 coprocessor. None of the moth-

The wave to catch!

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What about a Micro Channel based system? Turn the page once more.

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CIRCLE 251 ON READER SERVICE CARD

Destiny Computers builds its 16-, 20- and 25-MHz units according to dealers' specifications. The evaluated Destiny 386-20, designed around an AMI motherboard, came in a small-footprint case. The 386-25 tower uses another AMI motherboard with Intel's cache controller.

erboards will accept RAM directly, but instead work with various 32-bit Micronics memory boards.

Some of the memory boards are available with caching and can support up to 16MB of RAM. Each board also supports 128K of shadow RAM to speed up the operation of both system and video BIOS.

DESTINY 386-16 The small-footprint 16-MHz computer is based around the Micronics 386 system board and M200 main memory board. The memory board, which does not offer caching, was populated with 4MB of 100-nanosecond, 1-megabit page-mode DRAM, expandable to 8MB. Memory extension boards with 2, 4, or 8MB of additional RAM may be piggybacked onto the memory board.

Three of the test machine's eight expansion slots were already occupied—the 32-bit proprietary slot with the Micronics memory card, a full-length 8-bit slot with a video card, and a full-length 16-bit slot with the controller card. You're left with one half-length, 8-bit slot and four 16-bit slots, only one of which is full length. All five half-height drive bays are accessible from the front of the unit.

You'll find power and turbo reset switches on the front of the machine's attractive case. Although this may sound very convenient, only the reset switch really is. The turbo switch just turns the memory board caching on or off—no great help when you have a memory board that doesn't include cache RAM. And the location of the power switch is such that if you accidentally bump your keyboard into the machine, you can easily hit the switch and turn the system off. I inadvertently did this several times while reviewing this computer, with disastrous results.

The system was shipped with a VIP CGA card and a Casper CGA monitor, which is nothing to get enthusiastic about. At least their presence proves that Destiny can supply you with a machine configured just about any way you could possibly imagine.

DESTINY 386-20 The 20-MHz member of the Destiny 386 family was packaged in the same attractive but functionally lacking case as its 16-MHz sibling. The unit was designed around the Micronics Baby 80386 system board and included the Model 400C main memory board. The memory board contained 4MB of 100-nanosecond, 1Mb page-mode DRAM and, to speed things up, an Austek cache controller chip that handles a four-way-associated 32K static RAM cache. This memory board can accommodate up to 8MB but doesn't support memory extension boards, as the M200 model does.

Of the eight expansion slots, two 8-bit and three 16-bit were left free. The main memory card occupied the proprietary 32-bit slot, the Adaptek controller card occupied the full-length 16-bit slot, and Genoa's 16-bit VGA card occupied another 16-bit slot. The system came equipped with the Relisys RE-9513 VGA monitor, which, though somewhat undistinguished, was nevertheless an improvement over the CGA monitor combination shipped with Destinys 16-MHz unit.

DESTINY 386-25 Destiny's 25-MHz offering was housed in a nicely designed tower case with six half-height drive bays and reset, turbo, and power switches easily accessible on the box's front. It was designed around the relatively new Micronics 80386/25-MHz system board, which offers support for the Weitek 3167 coprocessor or coprocessor daughterboard, as well as Intel's 80387 coprocessor chip.

Unlike the Micronics motherboards in the other two Destiny computers, this system board has an Intel 82385 cache controller. The board comes with a 32K direct

PC MAGAZINE FACT FILE

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San Leandro, CA 94577
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(415) 430-8810

Destiny 386-16
List Price: With 1MB RAM, 1.2 MB 5¼-inch floppy disk drive, $2,306; with 60MB hard disk, monochrome monitor, DOS 3.3, $2,800; with VGA monitor, $3,300; with 4MB RAM, 106MB hard disk, CGA monitor, $5,225. 1MB RAM upgrade, $620.
CIRCLE **609** ON READER SERVICE CARD

Destiny 386-20
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, $2,500; with 60MB hard disk, monochrome monitor, DOS 3.3, $3,271; with VGA monitor, $3,780; with 4MB RAM, 106MB hard disk, $5,870. 1MB RAM upgrade, $620.
CIRCLE **610** ON READER SERVICE CARD

Destiny 386-25
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, $2,900; with 60MB hard disk, monochrome monitor, DOS 3.3, $3,846; with VGA monitor, $4,350; with 4MB RAM, 182MB hard disk, $7,000. 1MB RAM upgrade, $620.
CIRCLE **611** ON READER SERVICE CARD

In Short: Destiny Computers offers a wide variety of customization options for its 386 family of computers, which is sold through dealers only. The three machines—16 MHz, 20 MHz, and 25 MHz—were all solid performers on our benchmark tests.

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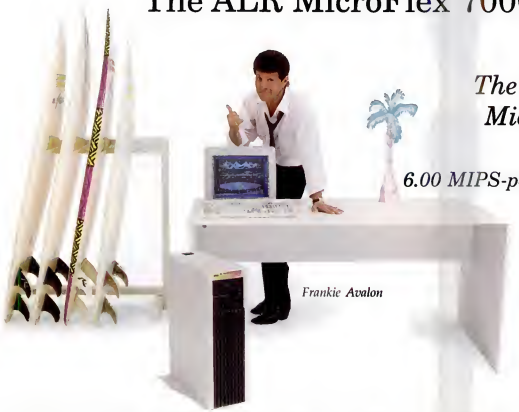

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Benchmark Tests: 16-MHz 386 Computers

Performance Times
(Times given in seconds except where noted)

	Processor and Memory Benchmark Tests				Disk Benchmark Tests		
	80386 Instruction Mix	Floating-Point Calculation	Conventional Memory	Extended Memory	DOS File Access (small record)	DOS File Access (large record)	BIOS Disk Seek (millisecond)
Fortron 386 18	4.69	17.35	0.85	9.00	61.96	18.11	28.89
Wang 381	4.20	16.42	0.76	8.85	48.28	16.96	27.74
Sanyo MBC-18 Plus	4.19	15.76	0.76	7.23	69.19	10.23	26.26
Mitac Paragon 386C	4.17	18.37	0.84	2.02	59.70	11.41	22.03
Leo 386/16	4.14	15.07	0.68	8.52	51.34	17.80	28.18
HITech SAM 3001/386	4.14	15.47	0.75	N/A*	51.27	17.66	29.99
Swan 386/16	4.14	17.25	0.84	14.38	59.35	18.55	39.64
Altec ZIP-386/16	4.12	15.49	0.75	N/A*	61.63	8.70	24.30
Amax PC/386-16	4.12	15.49	0.74	16.07	48.68	16.83	30.32
CompuAdd 386/16	4.12	15.51	0.73	11.26	48.80	17.72	31.51
Cordata CS 5000	4.12	16.20	0.78	16.13	60.33	8.38	29.14
DataWorld Data 386-16	4.12	15.54	0.75	16.07	50.66	17.72	28.36
HP Vectra QS/16	4.12	16.15	0.77	12.08	66.78	13.61	29.26
Destiny 386-18	4.12	15.56	0.77	11.26	63.78	5.23	16.79
Tandy 4000	4.12	16.09	0.76	9.94	64.76	5.85	23.46
TelOAS III 386/16	4.12	15.84	0.75	14.09	72.21	14.35	26.84
VIPC 386/16	4.12	15.58	0.73	10.59	50.32	10.05	N/A**
Canon A-200SX	4.10	14.89	0.67	9.59	48.81	17.75	30.87
Acer 1100/16	4.09	14.88	0.68	9.59	61.64	13.04	32.15
IBM PS/2 Model 70-E61	4.08	16.04	0.75	5.73	77.61	7.94	29.55
Mitsubishi MP386	4.07	14.83	0.64	18.55	51.24	18.29	27.78
PC Link 386-18	4.01	14.37	0.50	9.59	54.19	17.79	29.15
Leading Edge Model D3	3.96	15.80	0.75	14.37	66.61	8.23	30.83
Hertz 386/16	3.95	14.85	1.87	12.85	61.17	12.87	28.70
Amdek System/386e	3.90	14.59	0.60	9.83	53.01	17.70	30.30
NCR PC916	3.90	14.28	0.52	1.66	71.36	12.94	28.05
Wyse pc386	3.86	14.41	0.61	9.84	62.55	7.74	22.37
Zeos 386-16	3.79	13.60	0.57	5.92	73.32	8.77	17.03
Micro 1 Power 386-18	3.77	13.83	0.57	5.91	68.67	8.14	23.67
Spear 386A/18	3.78	13.67	0.57	7.80	72.06	13.82	38.81
GenTech 386	3.72	16.42	0.96	8.94	63.08	13.54	34.71
Everex Step 386/18	3.48	12.65	0.43	8.66	56.70	4.90	17.43
Bus 386/16	3.00	10.82	0.47	4.98	10.76	6.57	N/A**

N/A*—Not applicable: the tested system did not include extended memory.
N/A**—Not applicable: this machine's hard disk BIOS was not compatible with our test.

The **80386 Instruction Mix** benchmark test measures the time it takes to execute a selected series of processor-intensive tasks. The test program uses 80386 instruction code. These instructions are a subset of the total processor instruction set. The 80386 Instruction Mix implements a number of 32-bit operations. In the 80386 processor these become single instructions, whereas in the 8086 and 80286 versions of the benchmark test they remain multiple instructions.

The **Floating-Point Calculation** benchmark test measures processor speed by looping through a series of floating-point calculations, including multiplication, division, exponentiation, and logarithmic and trigonometric functions. The benchmark program uses the floating-point library included with Microsoft C Compiler 4.0.

The **Conventional Memory** benchmark test allocates 256K of conventional memory and treats it as a series of 64-byte records. Then, 16,384 random records are read into and written from this memory. The result shown is the average of the read and write times.

The **Extended Memory** benchmark test allocates 256K of extended memory and treats it as a series of 64-byte records. Then, 16,384 random records are read into and written from this memory. The result shown is the average of the read and write times.

The **DOS File Access** benchmark test measures the throughput rate of the disk being tested. In this case, throughput times are measured in terms of how long the disk takes to perform common DOS file-management functions. Five tasks—file creation, sequential file write, sequential file read, random file write, and random file read—are timed and the results summed.

The test is carried out for two different types of files—small-record files and large-record files—that are used by common PC applications. Files created using small records are typically used by database management programs, and large records are typically used for word processing and spreadsheet files. Loading a DOS program is also simulated by the large-record test.

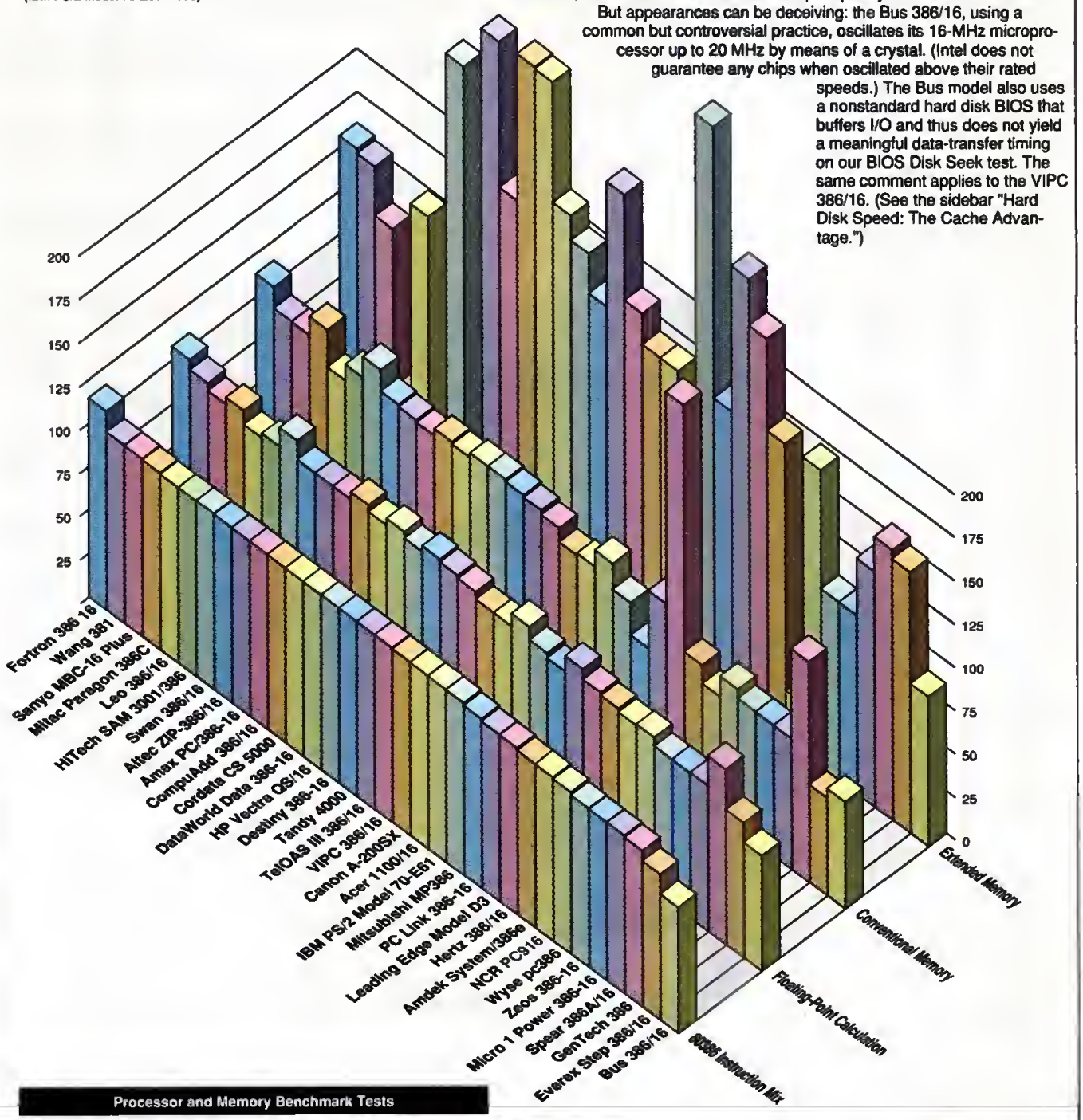
The **BIOS Disk Seek** benchmark test measures the time it takes to do a random seek using the disk's ROM BIOS. The test result includes minimal software overhead and may not parallel the manufacturer's claimed average access time. The test program performs 1,000 seeks. The average result is shown in milliseconds.

At the lowest level of 80386-based computers—those with microprocessors running at a mere 16 MHz—a given benchmark test can reveal a great difference between the fastest and slowest machines.

Note the wide variety of results listed for the Extended Memory test, from the NCR PC916's 1.66-second flurry to the Mitsubishi MP386's 18.55-second trudge. Superior performance can be attributed to several factors: RAM operating in page mode, which is inherently faster than row addressing; an interleaved-memory system of 2MB or more; and/or RAM caching, implemented either through software or through special SRAM chips set aside for the purpose.

The great spread among 16-MHz 386s can also be seen in PC Labs' small-record DOS File Access test, where IBM's PS/2 Model 70-E61 took 77.61 seconds, while the Bus 386/16 chalked up a speedy 10.76-second score.

But appearances can be deceiving: the Bus 386/16, using a common but controversial practice, oscillates its 16-MHz microprocessor up to 20 MHz by means of a crystal. (Intel does not guarantee any chips when oscillated above their rated speeds.) The Bus model also uses a nonstandard hard disk BIOS that buffers I/O and thus does not yield a meaningful data-transfer timing on our BIOS Disk Seek test. The same comment applies to the VIPC 386/16. (See the sidebar "Hard Disk Speed: The Cache Advantage.")



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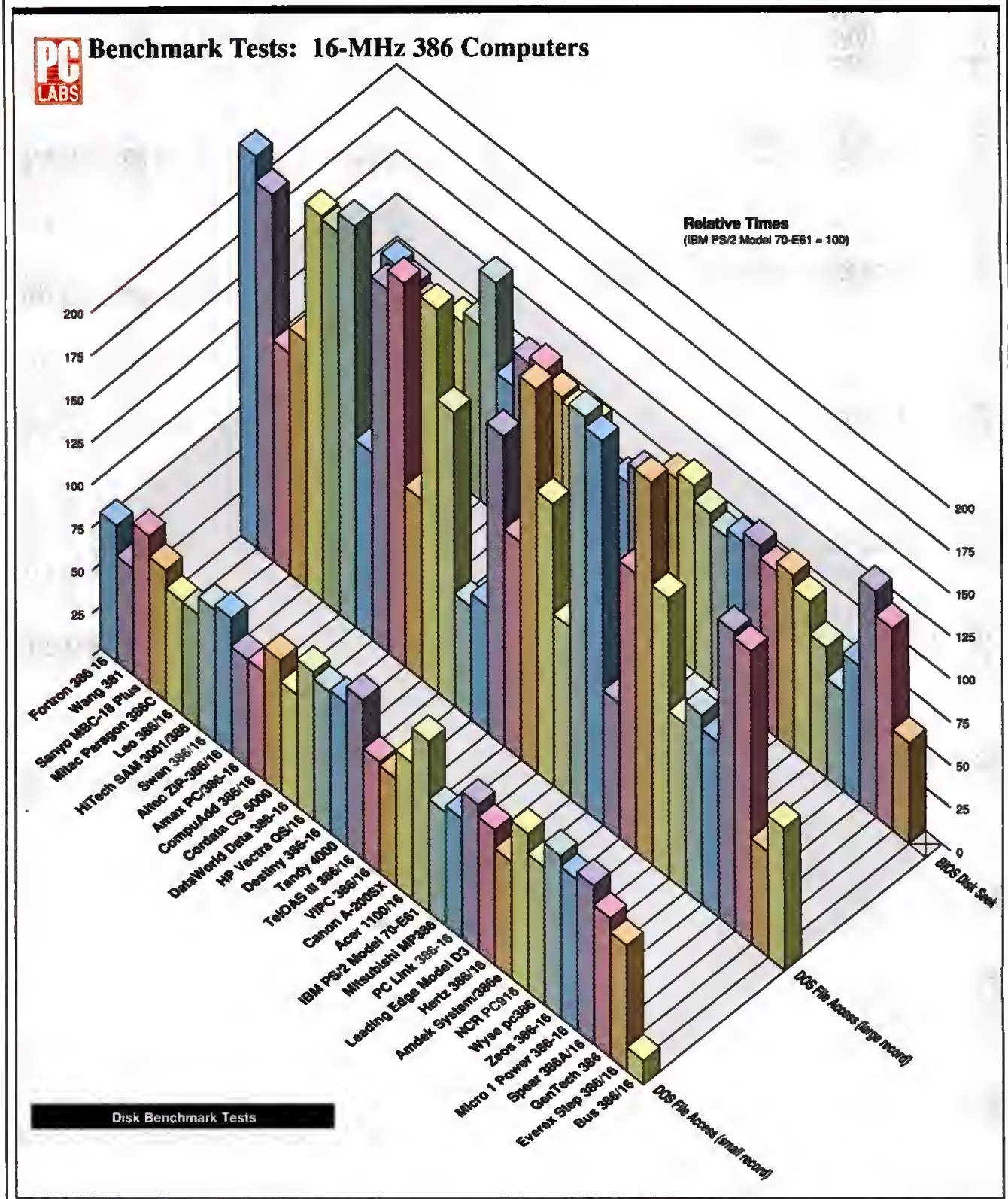
PC LABS
Benchmark Tests: 16-MHz 386 Computers
Relative Times
(IBM PS/2 Model 70-E61 = 100)
200
175
150
125
100
75
50
25
0
Fortron 386-16
Wang 381
Sanyo MBC-18 Plus
Mitac Paragon 386C
Leo 386/16
HiTech SAM 3001/386
Swan 386/16
Altec ZIP-386/16
Amax PC/386-16
CompuAdd 386/16
Cordata CS 5000
DataWorld Data 386-16
HP Vectra QS/16
Destiny 386-16
Tandy 4000
TelOAS III 386/16
VIPC 386/16
Canon A-200SX
Acer 1100/16
IBM PS/2 Model 70-E61
Mitsubishi MP386
PC Link 386-16
Leading Edge Model D3
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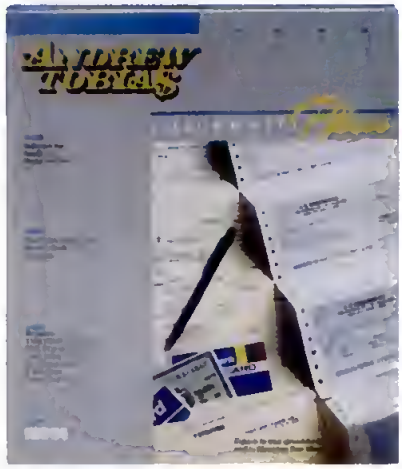

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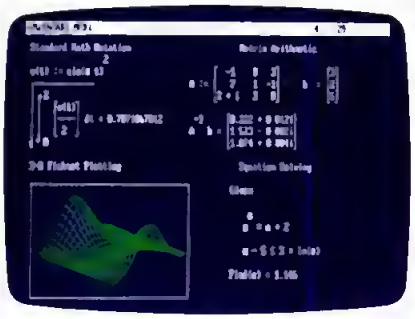

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map cache, with sockets for an additional 32K. Only one high-speed memory board option is available; it came to us with 4MB of 85-ns., 1Mb page-mode DRAM and can support an additional 4MB. The board's connectors allow for a daughterboard that can support another 8MB.

Three of the system's eight full-length expansion slots were occupied: the 32-bit slot contained the Micronics high-speed memory board, one 16-bit slot contained Genoa's 16-bit VGA card, and another 16-bit slot contained the Adaptek controller. Two 8-bit slots and three full-length 16-bit slots were left free.

In most of the benchmark tests, all three machines performed in the middle or at the high end of the curve in their respective classes. Much of this can be attributed to the solidity that comes from building a unit using high-quality parts.

Destiny offers free customer support and the standard 1-year parts and labor guarantee. But what makes the Destiny computers special is the custom-built touch. If you've always dreamed of owning a machine configured to your specifications, help is just a cooperative dealership away.—**Catherine D. Miller**

EVEREST COMPUTER CORP.
EVEREST BLOCK 320

Everest Computer Corp. sent us its XT-sized Everest Block 320, the fourth incarnation of its 20-MHz 386 system. For the bargain price of $1,995, you get 1MB of RAM, a 1.2MB floppy disk drive, a floppy/hard disk drive controller, a monochrome adapter (but no display), two serial and two parallel ports, a CMP-Everest motherboard, and the AMI BIOS.

But before being swayed by the fairly low price, take care to note some of the machine's limitations. Block is an appropriate description of this system, which appears to set up barriers to expansion at every turn. The four 8-bit slots seem like wasted capacity on a 386 machine, and a wire terminal plug interferes with the proper seating of a full-length board in one of the four 16-bit slots.

A 200-watt power supply, a system capacity of only 8MB of 32-bit RAM (oddly enough, you must choose between placing the memory on the motherboard or on a 32-bit card), the absence of cache memory, and a four-disk-bay capacity (three half-height accessible and one full-height internal) block any serious intentions of using this machine as a multiuser system or large file server. (You may find the optional $150 tower case (not reviewed), which comes with 250 watts of power and six half-height bays, slightly more congenial in a server situation.) The FCC Class A rating means that home business users, a potentially important market, can forget about making these boxes their personal machines.

ENHANCEMENTS, ALTERATIONS

Among the enhancements made to this latest system is the introduction of surface-mount technology to the Chips and Technologies VSLI chip set. The change was made to fix contact problems that arose from the previous socket-mount setup. The addition of a 32-bit slot would have been a more praiseworthy feature if the slot had been used to increase overall 32-bit system memory to 16MB or more, rather than serving as an option for housing the 8MB of 32-bit RAM that the unit actually does accommodate.

Unlike the previous (and no longer available) Everest 386/20, the Block 320 does not run its microprocessor at a potentially dangerous 24 MHz, although you can buy a 24-MHz crystal to increase its speed.

The system comes set with zero wait states and a 10-MHz bus speed. As the latter may cause compatibility problems, you'll be glad for the opportunity to slow it down or set alternate wait states (one, two, or three) for individual slots. Of course, you'll have to be prepared to spend the time finding the right combination of bus and processor speeds and wait states.

The $3,995 unit that we tested included a Seagate 72MB hard disk driven by an MFM Data Technology controller, a Genoa 8-bit Super VGA and, for some reason, a TECO EGA monitor. The test configuration, with the bus set to 10 MHz and running at zero wait states, produced only mediocre results on the benchmark tests.

New documentation is expected any day now, but in the meantime you can amuse yourself with the spelling and syntax of the old one. An excerpt: "Almost the 386 System were presented on the Personal Computer Market, used the RAM card to install the 386 Personal Computer. This configuation, will cause serveral disadvantages when you install or assemble your Personal Computer."

There is not much to commend this machine: it's not very well designed and is

The fourth incarnation of Everest's 20-MHz 386 system, the Everest Block 320, adds surface-mount technology to the VLSI chip set. A 32-bit slot has also been added to hold the 8MB of 32-bit RAM the system can accommodate.

FACT FILE

Everest Block 320
Everest Computer Corp.
1153 Tasman Dr.
Sunnyvale, CA 94089
(408) 734-2604
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, $1,995; with 60MB hard disk, monochrome monitor, DOS 3.3, $2,899; with VGA monitor, $3,608; with 2MB RAM, $3,995. 1MB RAM upgrade, $400; 150MB hard disk, $1,200.
In Short: This machine is inexpensive, but not the cheapest 20-MHz unit you can find. Its poor design will make expansion difficult, rendering it unsuitable for many business applications, and its FCC Class A rating makes it an unwise choice for home use.

CIRCLE 622 ON READER SERVICE CARD

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To all those unlucky enough to be stuck smack in the middle of the current spreadsheet confusion, take heart.

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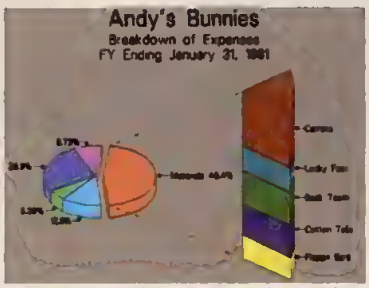

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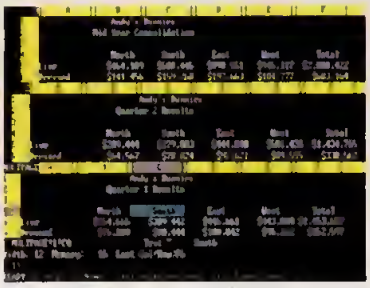

Link just about everything in sight.

And with SuperCalc5, you select fonts, lines, boxes, grids and shading. All of which can be used to produce the highest quality customized reports.

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Catch bugs before they come back to bite you.

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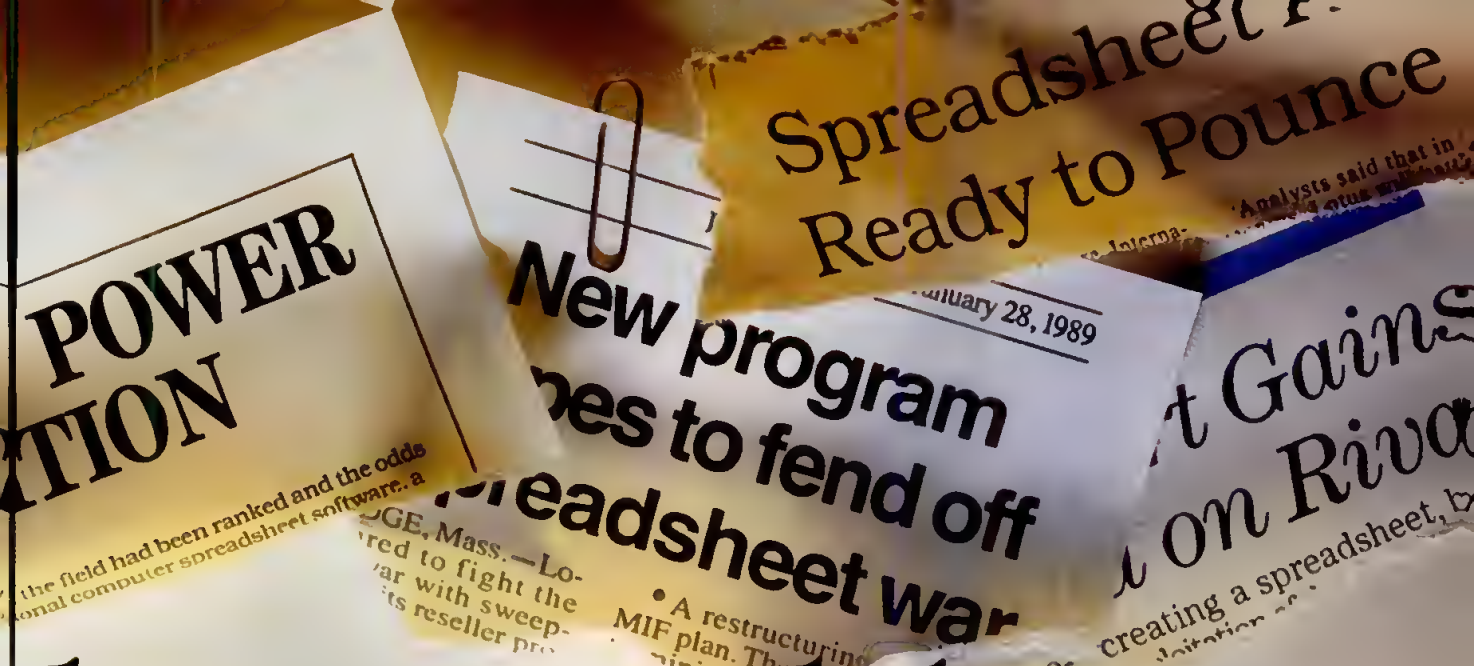
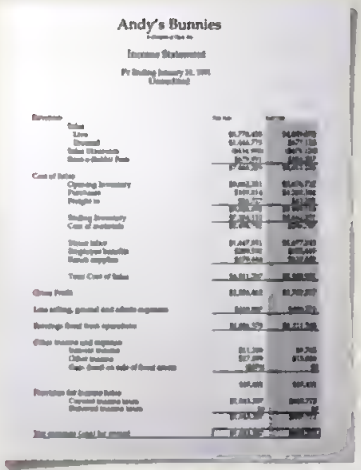


he Spreadsheet portant Update.

to be precise. Linking either in memory or on disk, either pages of the same spreadsheet or independent, either SuperCalc5's files or Lotus® 1-2-3®'s.



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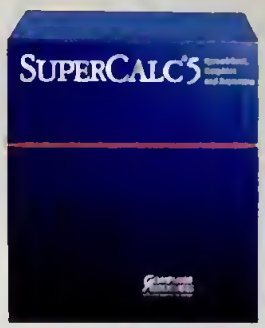

Which finally brings us to our admittedly biased outlook for the much touted spreadsheet war.

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CIRCLE 102 ON READER SERVICE CARD

PC LABS Benchmark Tests: 20-MHz 386 Computers

Performance Times (Times given in seconds except where noted)	Processor and Memory Benchmark Tests				Disk Benchmark Tests		
	80386 Instruction Mix	Floating-Point Calculation	Conventional Memory	Extended Memory	DOS File Access (small record)	DOS File Access (large record)	BIOS Disk Seek (milli-seconds)
CompuAdd 386/20	4.89	19.28	0.93	13.62	87.76	6.17	33.07
Olivetti M380/XP1	3.57	13.02	0.60	9.72	57.10	5.26	17.41
AT&T 6386 WGS	3.55	12.88	0.55	9.72	58.13	5.29	13.53
Top Gun 386/20	3.33	13.07	0.68	14.01	67.41	6.34	29.26
Memorex Telex 386-20	3.33	13 46	0.66	14 93	92.57	20.72	29.40
Tatung TCS-8000	3.33	13.44	0.68	21.25	57.34	8.59	18.53
SIVA AT386	3.31	13.71	0.74	6.70	66.31	8.29	17.04
Acer 1100/20	3.30	11.92	0.52	7.65	62.67	4.85	22.52
VIPC 386/20	3.30	13.45	0.67	4.84	49.09	11.35	N/A**
Wang 382	3.30	13.02	0.60	8.85	47.68	18.87	26.23
Arche Rivsl 386	3.29	13.41	0.66	11.49	81.44	12.93	24.79
Swan 386/20D	3.29	13 40	0.67	14.35	67.37	4.88	16 84
Cordata CS 5000-2	3.28	12.87	0 60	33.43	36.69	7.58	28.27
Mitac Paragon 386E	3.28	12.54	0.59	6 94	85.98	13.91	28.06
Altec ZIP-386/20	3.26	12.41	0.59	8.77	50.71	21.49	39.48
UTI 386/20	3.26	12.69	0.60	4.45	70.01	9.01	31.23
NEC PowerMate 386/20	3.26	12.82	0.60	19.16	41.58	5.38	18.88
Everest Block 320	3.24	12.84	0.60	5.91	70.25	8.15	31.60
IBM PS/2 Model 70-121	3.24	12.72	0.61	2.21	73.98	6.70	25.27
Tandy 4000LX	3.24	12 86	0.60	8.01	71.04	6.77	30 59
PC Link 386-20	3.21	11.44	0.40	7.66	56.86	5.24	18.73
Spear 386D/20	3.17	12.40	0.55	N/A*	63.98	5.16	23.93
Destiny 386-20	3.15	11.84	0.50	16.06	64.17	5.72	17.54
Pacer 386 20	3.13	12.63	0.60	4.67	55.95	8.14	31.93
Fountain 386/20	3.09	11.39	0.42	16.07	44.48	8.75	22.39
Amax PC/386-20	3.08	11.35	0.85	20.60	49.14	16 35	24.44
PC Designs 386-20 Plus	3.02	10.82	0.47	5.45	85.08	7.77	41.16
AST Premium/386C	3.00	10.98	0.40	6.49	56.47	5.26	17.74
Bus 386/20	3.00	10.84	0.45	9.98	10.60	5.98	17.80
DataWorld Data 386-20	3.00	10.82	0.47	5.00	64.74	5.99	N/A**
FiveStar Model 320	3.00	10.82	0.47	5.47	89.74	8.16	23.94
Fortron 386 20 Plus	3.00	10.82	0.46	4.99	49.04	17.17	30.19
Core ATomizer 386/20	2.98	10 82	0.47	5 45	66.88	5.47	30 38
CPU 386/20	2.97	10.82	0 46	4.99	67.31	18 30	17.72
Tandon 386	2.97	10 82	0.45	5.53	52.05	24.20	25.61
Compaq Deskpro 386/20e	2.91	10.54	0.40	2.26	56.42	5.45	30.83
HP Vectra RS/20	2.89	10.43	0.38	12.08	67.69	7.09	24.19
MicroLab 386/20	2.89	10.42	0.40	4.22	46.98	17.04	18.18
Tandy 5000MC	2.89	10.51	0.39	1.41	68.82	7.95	28.34
Micro Express 386-20	2.88	10.47	0.39	4.24	62.27	5.07	18 42
Zeos 386-20	2.87	10.40	0.39	4.23	60.11	6.10	16.46
ALR FlexCache 20386DT	2.86	10.38	0.35	11.93	61.66	5.24	28.44
Dell System 310	2.86	10.54	0.38	1.78	57.34	5.55	25.43
Micro 1 Power 386-20	2.86	10.42	0.39	4.22	64.03	4.92	16.31
Northgate Elegance 386/20	2.84	10.33	0.44	10.96	62.99	5.90	25.74
Everex Step 386/20	2.76	10.10	0.35	4.95	58.10	4.92	17.96

N/A*—Not applicable; the tested system did not include extended memory. N/A**—Not applicable; this machine's hard disk BIOS was not compatible with our test.

The **80386 Instruction Mix** benchmark test measures the time it takes to execute a selected series of processor-intensive tasks. The test program uses 80386 instruction code. These instructions are a subset of the total processor instruction set. The 80386 Instruction Mix implements a number of 32-bit operations. In the 80386 processor these become single instructions, whereas in the 8086 and 80286 versions of the benchmark test they remain multiple instructions.

The **Floating-Point Calculation** benchmark test measures processor speed by looping through a series of floating-point calculations, including multiplication, division, exponentiation, and logarithmic and trigonometric functions. The benchmark program uses the floating-point library included with Microsoft C Compiler 4.0.

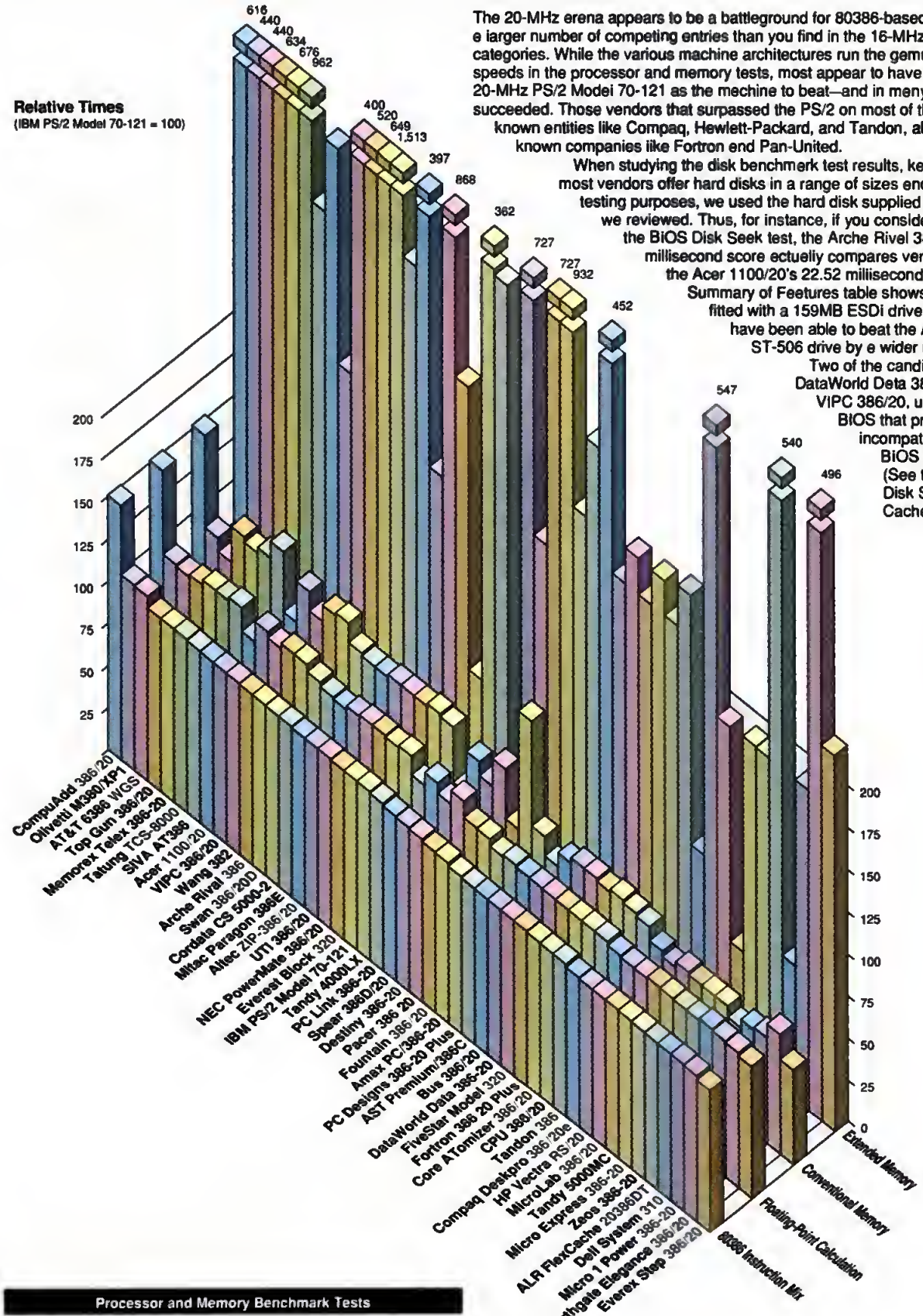
The **Conventional Memory** benchmark test allocates 256K of conventional memory and treats it as a series of 64-byte records. Then, 16,384 random records are read into and written from this memory. The result shown is the average of the read and write times.

The **Extended Memory** benchmark test allocates 256K of extended memory and treats it as a series of 64-byte records. Then, 16,384 random records are read into and written from this memory. The result shown is the average of the read and write times.

The **DOS File Access** benchmark test measures the throughput rate of the disk being tested. In this case, throughput times are measured in terms of how long the disk takes to perform common DOS file-management functions. Five tasks—file creation, sequential file write, sequential file read, random file write, and random file read—are timed and the results summed.

The test is carried out for two different types of files—small-record files and large-record files—that are used by common PC applications. Files created using small records are typically used by database management programs, and large records are typically used for word processing and spreadsheet files. Loading a DOS program is also simulated by the large-record test.

The **BIOS Disk Seek** benchmark test measures the time it takes to do a random seek using the disk's ROM BIOS. The test result includes minimal software overhead and may not parallel the manufacturer's claimed average access time. The test program performs 1,000 seeks. The average result is shown in milliseconds.



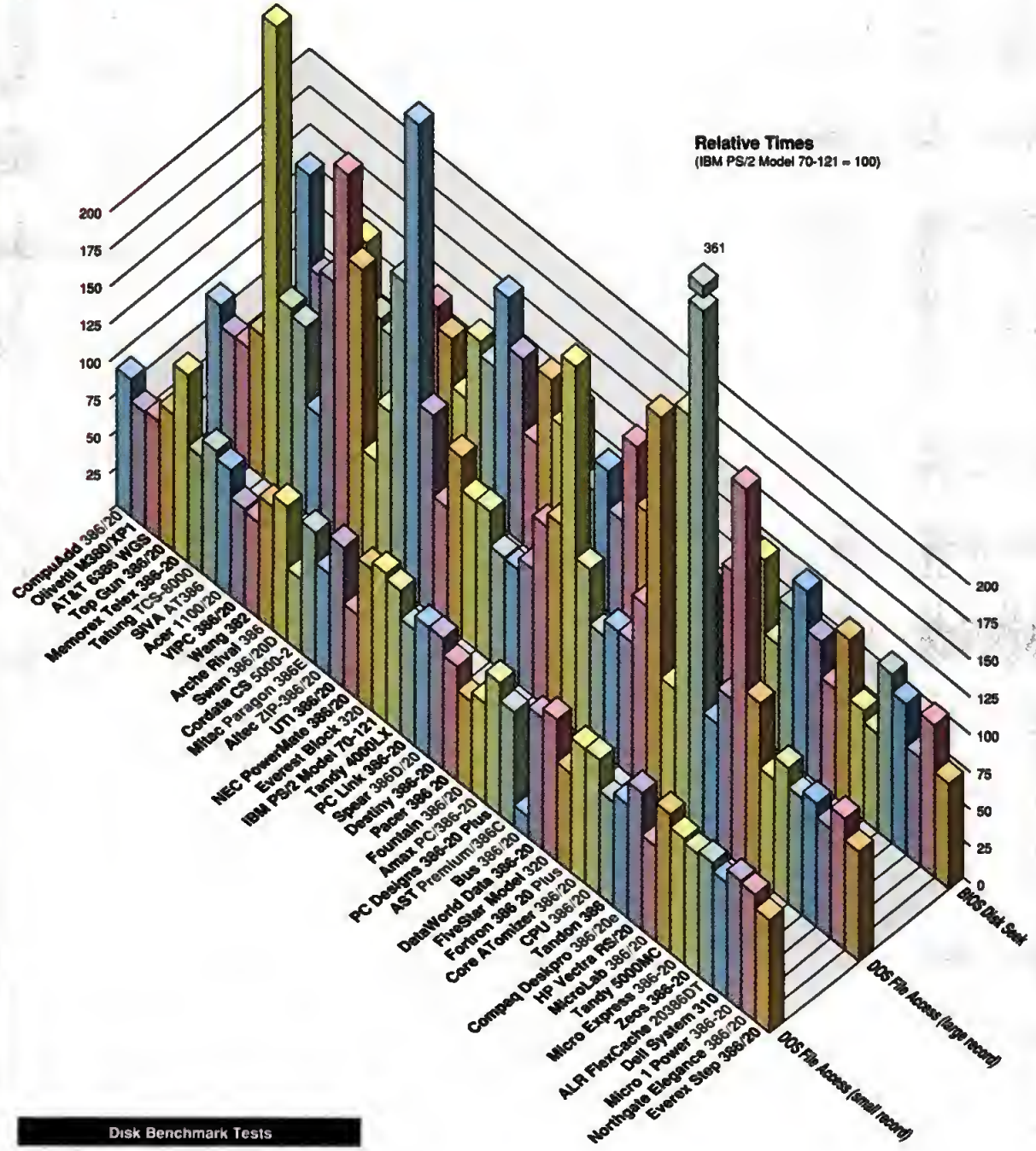
Processor and Memory Benchmark Tests

The 20-MHz erena appears to be a battleground for 80386-based mechines, with e iarger number of competing entries than you find in the 16-MHz or 25-MHz categories. While the various machine architectures run the gemut of possible speeds in the processor and memory tests, most appear to have targeted iBM's 20-MHz PS/2 Modei 70-121 as the mechine to beat—and in meny cases have succeeded. Those vendors that surpassed the PS/2 on most of the tests include known entities like Compaq, Hewlett-Packard, and Tandon, along with lesser-known companies iike Fortron end Pan-United.

When studying the disk benchmerk test results, keep in mind that most vendors offer hard disks in a range of sizes end speeds. For testing purposes, we used the hard disk supplied with the system we reviewed. Thus, for instance, if you consider the context of the BiOS Disk Seek test, the Arche Rivel 386's 24.79-millisecond score ectuelly compares very fevorably with the Acer 1100/20's 22.52 milliseconds. As the Summary of Feetures table shows, the Acer is fitted with a 159MB ESDi drive, which should have been able to beat the Arche's 66MB ST-506 drive by e wider margin.

Two of the candidetes, the DataWorld Deta 386-20 and the VIPC 386/20, used a hard disk BIOS that proved incompatible with our BiOS Disk Seek test. (See the sidebar "Hard Disk Speed: The Cache Advantage.")

Benchmark Tests: 20-MHz 386 Computers



limited in current capability and expansion capacity. It doesn't fit into the home business users' niche, nor is it a corporate server system.

An interesting aside is that Everest has chosen to pay royalties to IBM in a rollover response to Big Blue's lawsuit against all clone manufacturers.

—Kate Emery

EVEREX COMPUTER SYSTEMS
EVEREX STEP 386/16
EVEREX STEP 386/20
EVEREX STEP 386/25

Everex Computer Systems, a company known mostly for its peripherals, has been in the PC manufacturing business for 2 years now. But it is only within the last year that the company has begun selling its machines under its own label. The introduction of its 386 line, composed of 16-, 20-, and 25-MHz machines, ensures the company a place in the pace-setting pack that includes ALR and Dell.

The Everex Step 386/16, 386/20, and 386/25 (base priced at $3,699, $4,199, and $4,999, respectively) are identical in most areas, from the proprietary Everex BIOS to the desktop-style chassis with five half-height drive bays and a 200-watt power supply to the excellent speed ratings achieved through the use of a proprietary caching system.

Of course, there were differences among the units we received for review. The Step 386/16 came with 2MB of on-board RAM (128K 35-nanosecond cache), an 80MB Seagate 4096 hard disk, an MFM-coded Scientific Micro Systems controller, a 1.2MB 5¼-inch floppy disk drive, one serial and one parallel port, an EGA monitor, and DOS 3.3, at a cost of $5,337. Change the processor speed to 20 MHz, upgrade the hard disk to a 330MB CDC unit, substitute a Western Digital ESDI controller, up the on-board RAM to 4MB (64K 35-ns. cache), and raise the price to about $10,547, and you get the Step 386/20 test unit. A similar configuration on the 25-MHz unit, with a 25-ns. cache, will run you $12,047.

The front panel on each machine is a graceful merger of aesthetics, innovation, and functionality. A smoke-colored plastic door slides away to display the eight-character LED control panel; its flashing indicator lights track bootup as well as drive, cylinder, and head access operations. The internal Power and Run LED indicator signals diagnostic information by changing colors: red indicates power-on; green indicates that the CPU is performing a calculation. Everex even added an on/off switch for the computer's speaker, especially handy when running particularly noisy applications.

A three-position hardware speed switch is also built into the front panel of the Step systems. When the switch is set to the top position, the systems run at high speed; at the low position, the 16-, 20-, and 25-MHz machines crank along at 5, 6.7, or 8 MHz, respectively. At the middle position, the system boots at high speed, although you can change it with a key combination or by using the utility program included.

There is room for up to 8MB of SIMM modules on the motherboard of each machine, so you may not need to load a memory expansion card, capable of adding an additional 8MB, into the 32-bit slot that comes standard. Five slots are free when a floppy/hard disk drive controller, one serial and one parallel port, and a video adapter are installed.

The Everex Step 386/25, like its 16- and 20-MHz brethren, uses a proprietary caching scheme that gives a big speed boost without using superfast chips. Aesthetics and functionality combine in the front panel: a smoke-colored plastic door slides away to reveal an eight-character LED control panel.

INNOVATION WITH PURPOSE The Everex machines are full of innovations with purpose as well as flair. Most notable is the proprietary caching system that gives a tremendous speed boost to the machines without using superfast (and expensive) chips. All the systems came in very near the top of their classes on our benchmark tests; they achieved these ratings with 150-ns. chips in the 16- and 20-MHz machines and a 120-ns. chip in the 25-MHz box.

Everex 386s are full of innovations with purpose as well as flair.

The company's proprietary caching scheme is an integral part of the Advanced Memory Management Architecture (AMMA), a memory management design similar to those found on minis and mainframes. The caching scheme works by fetching blocks of 4, 8, or 16 bytes of data for cache sizes of 64K, 128K, and 256K, respectively. You calculate your configuration's requirements by noting the number of memory banks you have filled: if you have only one bank of memory, 64K will be sufficient. For two banks, you will need 128K, and for four banks, 256K.

Everex's caching scheme gains some of its advantage by using a one-to-one mapping of main memory addresses to cache location. No overhead is wasted finding out where in cache a piece of information might be found. Lastly, with write-back rather than write-through caching, you will gain a performance advantage by not writing through to memory each time the cache is updated. Instead, AMMA waits until a cache location is going to be overwritten before writing back to RAM.

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■ 80386 DESKTOP PCs

Two utilities come with all three of the Everex systems to further boost throughput: EDISK RAM software is included to create a RAM disk of any size in base, extended, or expanded memory; EVCACHE disk caching software increases disk performance.

LATEST IMPROVEMENTS The latest improvements made to these 386s include the ability to configure all hardware through setup software; no jumpers or DIP switches need to be set. For further convenience, the coprocessor socket has been taken out from underneath the power supply. By the time this review is printed, vid-

PC MAGAZINE FACT FILE

Everex Computer Systems
48504 Kato Rd.
Fremont, CA 94538
(800) 356-4283
(415) 498-1111

Everex Step 386/16
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, DOS 3.3, $3,699; with 40MB hard disk, monochrome monitor, $4,597; with EGA monitor, $5,147; with 80MB hard disk, $5,377. 160MB hard disk, $2,149;

CIRCLE 542 ON READER SERVICE CARD

Everex Step 386/20
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, DOS 3.3, $4,199; with 40MB hard disk, monochrome monitor, $5,097; with EGA monitor $5,868; with 4MB RAM, 330MB hard disk, EGA monitor, $10,547.

CIRCLE 543 ON READER SERVICE CARD

Everex Step 386/25
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, DOS 3.3, $4,999; with 40MB hard disk, monochrome monitor, $7,045; with EGA monitor, $7,427; with 4MB RAM, 330MB hard disk, EGA monitor, $12,047.

CIRCLE 544 ON READER SERVICE CARD

In Short: None of these machines is cheap, but careful design and good construction make them well worth considering. The latest improvements made to all three include the ability to configure all hardware through setup software and the relocation of video BIOS to shadow RAM.

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eo BIOS will join the system BIOS in being relocated to shadow RAM, which should improve the video refresh.

None of these machines come cheap, but if you've got a need for speed—as well as an eye for fine details and a well-thought-out design—you should take them into consideration. **—Kate Emery**

FIVESTAR COMPUTERS
FIVESTAR MODEL 320

The 20-MHz FiveStar Model 320 from FiveStar Computers gets three stars. The $2,049 base system comes in an attractive 43-pound case that holds 1MB of RAM, a 1.2MB floppy disk drive and controller, and an 8-bit I/O card with serial, parallel, and game ports. While none of this is out of the ordinary, upon closer inspection you will find perks that set the Model 320 a notch above the one- and two-star machines.

The USA-made Mylex motherboard sports the 256K AMI BIOS. This BIOS uses 128K more ROM than many other BIOS chips on the market. The extra ROM is used to house setup, diagnostics, and an EGA BIOS. The on-board EGA BIOS, which can be enabled through a switch, can be used in place of an EGA board so that monitor instructions do not have to be carried over the slower bus. This results in much faster video speeds without RAM shadowing. If you have a VGA monitor-and-card combination, however, only the EGA functions will be speeded up. The motherboard will also support the Intel 80387 coprocessor, but not the Weitek modules.

The FiveStar Model 320 uses the 256K AMI BIOS, which has 128K more ROM than many others. Part of the extra ROM houses an EGA BIOS that can be used in place of an EGA board, resulting in faster video speeds without RAM shadowing.

The power supply is a 230-watt A-Matic with five power connectors. This will furnish ample power for the devices with which you can populate the five half-height bays (three of which are accessible from the front).

SPECIAL TOUCHES An FCC Class A rating makes it unsuitable as a home-office machine, but with options for a $799 60MB internal tape drive and seven hard disks ranging from a $500 45MB to a $1,560 130MB unit, it would certainly be an adequate office engine.

Instead of the typical lithium battery, FiveStar uses a Dallas Semiconductor battery pack that contains the clock chip, battery, and CMOS in one small package the size of an EPROM. The Dallas pack can be either soldered or plugged into the motherboard and is designed to last 10 to 12 years, compared with the 3-to-5-year life expectancy of most lithium batteries.

The $5,424 evaluation unit we received came equipped with an 80MB Seagate hard disk, a second 1.44MB 3½-inch, 1.44MB floppy disk drive, a 16-bit Paradise VGA card, an Xtron multiscanning monitor, and 2MB of 32-bit RAM.

The maximum 32-bit system memory that the model 320 will carry is 16MB, with 8MB on the motherboard and another 8MB on a 32-bit card. The fast 80-nanosecond RAM combined with a 64K 25/35-ns. cache—the first 12K of cache memory is rated at 25 ns., the remaining at 35 ns.—helps the machine perform smoothly at 20 MHz with zero wait states. Through the keyboard you can select between zero- and one-wait-state operation, as well as 20- or 6-MHz CPU speed, and 10- or 6-MHz bus speed. In most of our benchmark tests, the machine ran respectably, coming out in the middle of the pack.

The FiveStar Model 320 is not the superstar that its name might indicate, but it is a solid machine with thoughtful extras, making it a sound investment.
—Kate Emery

PC MAGAZINE FACT FILE

FiveStar Model 320
FiveStar Computers
1621 West Crosby
Carrollton, TX 75006
(800) 752-5555
(214) 242-7000
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, $2,049; with 80MB hard disk, monochrome monitor, DOS 3.3, $2,965; with VGA monitor, $3,664; with 2MB RAM, 1.2MB 5¼-inch and 1.44MB 3½-inch floppy disk drive, $4,300. 1MB RAM upgrade, $531; 130MB hard disk, $1,560; 60MB tape backup, $799.
In Short: The FiveStar Model 320 is a three-star, solid machine with many thoughtful extras including setup, diagnostics, and EGA BIOS in ROM; on-site service; and a special battery pack that contains the clock chip, battery and CMOS in an EPROM-sized packet. An FCC Class A rating makes it unsuitable as a home-office workstation, but overall it's a good offering for the price.
CIRCLE **641** ON READER SERVICE CARD

FORTRON CORP.
FORTRON 386 16
FORTRON 386 20 PLUS
FORTRON 386 25

Fortron Corp. doesn't manufacture most of the components found in its three 386 systems, but the parts it does use are solid and its prices are attractive. Fortron's test selection included 16- and 20-MHz full-sized desktop units and a 25-MHz tower model, base priced at $2,400, $2,900, and $3,900, respectively.

The cases that house the machines are all sturdy, with reset switches on the front and Fortron's own hefty 230-watt power supplies within. Each power supply has connectors for the maximum five floppy, hard, or tape drive units that each system can hold.

All three systems come with a Tatung Enhanced-style keyboard, a pretty good

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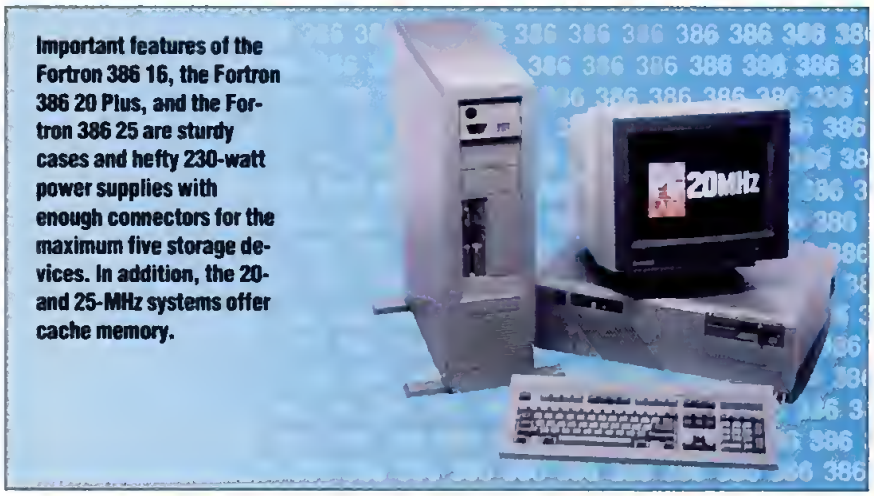
CIRCLE 187 ON READER SERVICE CARD

model although some users may find that it feels a tad on the rubbery side. The machines also use a Western Digital floppy/hard disk controller with a 1:1 interleave.

Also standard are a 1.2MB floppy disk drive, a minimum of 1MB of RAM, and at least one serial and one parallel port. The best selection of standard equipment is found on the 16-MHz machine, which comes complete with 2MB of RAM and two serial ports.

Intel processor chips and system chip sets grace the motherboard in each machine. Fortron makes its own Intel-compatible motherboard for the 16-MHz unit but uses AMI motherboards for the 20-MHz and 25-MHz systems.



Important features of the Fortron 386 16, the Fortron 386 20 Plus, and the Fortron 386 25 are sturdy cases and hefty 230-watt power supplies with enough connectors for the maximum five storage devices. In addition, the 20- and 25-MHz systems offer cache memory.

PC MAGAZINE FACT FILE

Fortron Corp.
6818 Patterson Pass Rd., Suite G
Livermore, CA 94550
(800) 821-9771
(415) 373-1008

Fortron 386 16
List Price: With 2MB RAM, 1.2MB 5¼-inch floppy disk drive, $2,400; with 60MB hard disk, monochrome monitor, DOS 3.3, $3,400; with VGA monitor, $3,700; with 40MB hard disk, $3,465.
CIRCLE **425** ON READER SERVICE CARD

Fortron 386 20 Plus
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, $2,900; with 60MB hard disk, monochrome monitor, DOS 3.3, $3,900; with VGA monitor, $4,200; with 2MB RAM, 80MB hard disk, 80387-20 coprocessor, $5,300.
CIRCLE **426** ON READER SERVICE CARD

Fortron 386 25
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, $3,900; with 60MB hard disk, monochrome monitor, DOS 3.3, $4,900; with VGA monitor, $5,200; with 4MB RAM, 141MB hard disk, tower case, $7,900.
CIRCLE **427** ON READER SERVICE CARD

In Short: Are you afraid you can't afford a much-needed 386 machine? Fortron gives you some of the least expensive ways to get one while still using standard components. These machines aren't terribly unique, but they're priced aggressively and come with a 1-year on-site service warranty.

FORTRON 386 16 The $2,400 base price of this system is pretty seductive; even our test system, with a 40MB Seagate drive, DOS, Tatung VGA monitor, and 8-bit Everex VGA controller, is a good deal at $3,465. Home business users who like the price will also be relieved to know that this system, unlike the other two Fortrons, garners an FCC Class B rating.

The system's Fortron motherboard is compatible with Intel's own and includes one parallel and two serial ports built in. Also on the motherboard is the Phoenix ROM BIOS and the 16-MHz processor chip, which can be throttled down to 8 MHz by using a keyboard combination.

Besides two 32-bit slots, you get two 8-bit and four 16-bit slots, running on an expansion bus controlled at a straight 8 MHz, a comfortable speed for older boards.

As with many other systems reviewed in this issue, base RAM is installed in 256-kilobit chips on a 32-bit memory card, which has a maximum capacity of 8MB, using 1-megabit chips. The addition of a second 32-bit card can bring system memory up to 16MB. If you think you're going to need all the memory you can get, it's probably better to specify 1-megabit chips at the outset.

The Fortron motherboard will accommodate more coprocessors than the AMI motherboards on their siblings. The full line—80287, 80387, and Weitek math coprocessor chips—is supported here.

Generally this machine runs at zero wait states, but you can change it to one wait state through the setup program. There is no cache memory or shadowing of video and BIOS ROM, but a 2:1 memory interleave scheme is used to increase performance. Even so, the Fortron 386 16 wound up in the lower range of the midlevel machines.

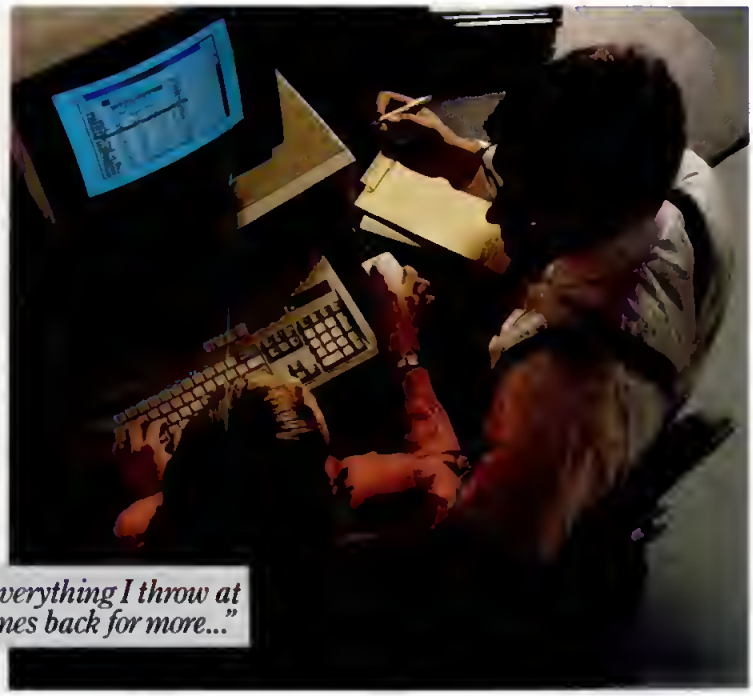
FORTRON 386 20 PLUS The "Plus" in the system's name refers to the 64K of 29-nanosecond cache memory, run by an AMI K8 controller chip. The cache is a significant factor, helping the machine to score in the high range of the midlevel units on our benchmark tests.

The 20-MHz model has only one 32-bit slot for system RAM, but you can use it to install a single memory card that can cram 16MB—as much memory as occupied two 32-bit slots on the 16-MHz model. While both systems come with eight slots total, the ability to fit the memory onto a single card means you get more room for expansion in the 20-MHz system: six 16-bit and one 8-bit slot remain after boosting the memory to the max.

The expansion bus runs at an unalterable 10 MHz, so be careful about using older cards in this machine. If you need to put the brakes on somehow, the true 20-MHz Intel 80386 processor chip can be slowed to 10 MHz using the keyboard.

The AMI motherboard, which uses the AMI ROM BIOS chips, combines zero wait states, 1:1 memory interleaving, and both video and ROM BIOS shadowing. If you perform heavy math calculations, the

WORD IS OUT ON THE PC LINK-386!



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— Richard Hausman, Belding Heminway

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— Winn Rosch, PC Magazine

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PC Link Corp. 29 West 38 St., New York, NY 10018, In New York: (212) 730-8036

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CIRCLE 245 ON READER SERVICE CARD

motherboard on both this and the 25-MHz unit will take 80387 or Weitek coprocessor chips. Unlike their less-speedy sibling, neither of these machines can give the 80287 a home.

The test machine had 2MB RAM, a Seagate 80MB hard disk drive, and a Tatung 8-bit VGA card and Tatung VGA monitor. The list price for this configuration is $4,795—very aggressive for this category.

FORTRON 386 25 The top-of-the-line Fortron 386 25 was impressive in its optional $100 tower case. Even configured with 4MB of 80-ns. RAM; 141MB, 18-millisecond ESDI CDC hard disk drive and ESDI controller; 16-bit Video Seven VGA adapter and monitor; and DOS, the unit lists at just $7,900. Eight thousand dollars begins to sound like pretty serious money, but other machines that suffer this much RAM and such a hefty hard disk drive often cost half again as much, so keep reading.

As in the 20-MHz unit, the motherboard, ROM BIOS, and cache controller are AMI's; however, there are some important differences between the two units that are worth noting. Up to 8MB of memory, for instance, can be installed directly onto the 25-MHz motherboard in SIMM chip packs.

With an additional 16MB available through a memory card in the single 32-bit expansion slot, you can pack in a grand total of 24MB of 32-bit memory. Current versions of DOS and OS/2 can't use or get along with that much, but other operating systems can, and it's a good bet that someone eventually will figure out how to get DOS and OS/2 to work with that much RAM. Any user who was a Boy or Girl Scout will recognize the value of the motto "Be prepared."

The number and type of expansion slots mirror those found in the 20-MHz system, but in this case the bus runs at 8.3 MHz, a fairly safe bet for most cards sold since 1985.

The 64K of cache memory on this machine is 25-ns., 4 ns. faster than on the 20-MHz computer. Additional speedups include programmable 1:1 memory interleaving and RAM shadowing of both video and ROM BIOS. Even so, the 25-MHz model was unable to burst ahead of the other middle-of-the-road performers.

Fortron offers the standard 1-year parts and labor warranty on all its systems, but it does so in a special way: all service is performed on-site by ServerNet, a nationwide contract service organization.

The Fortron 386s have good, standard components, speedy enough performance, and reasonable prices. Combine that with 1 year's on-site service, and the Fortrons come out as very attractive options.

—Bruce Brown

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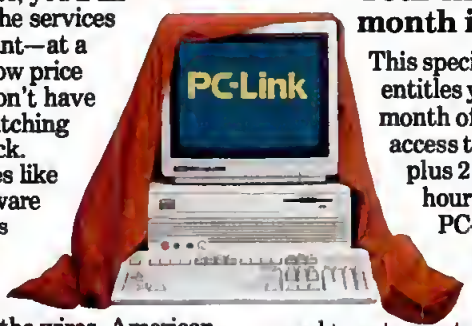

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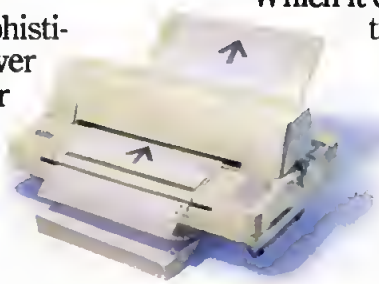

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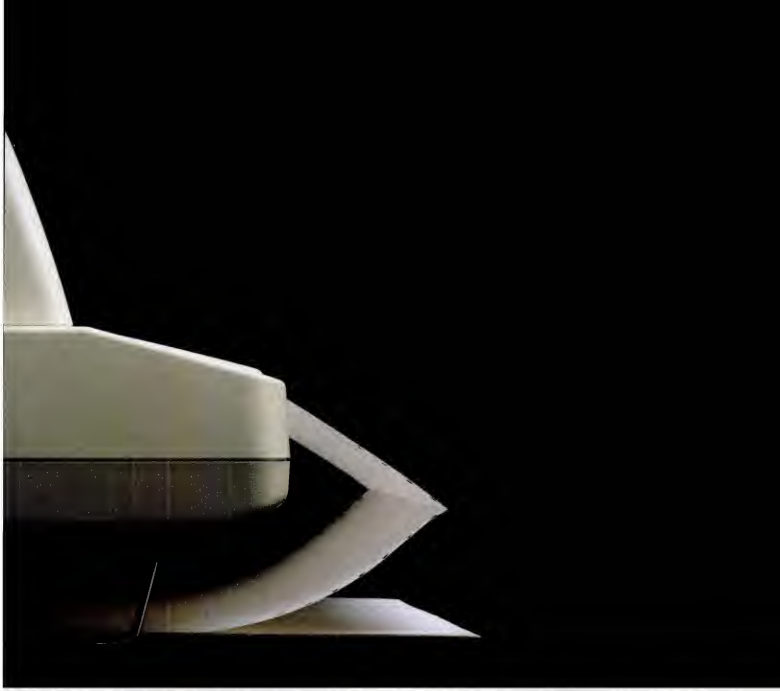

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Benchmark Tests: 25-MHz 386 Computers

Performance Times

(Times given in seconds except where noted)

	Processor and Memory Benchmark Tests				Disk Benchmark Tests		
	80386 Instruction Mix	Floating-Point Calculation	Conventional Memory	Extended Memory	DOS File Access (small record)	DOS File Access (large record)	BIOS Disk Seek (milli-seconds)
Top Gun 386/25	2.69	11.61	0.67	14.01	66.06	6.09	30.01
Zenith Z-386/25	2.83	9.45	0.53	2.97	62.03	7.03	16.22
CompuAdd 386/25	2.47	9.08	0.38	10.71	62.10	4.65	14.28
Hertz 386/25	2.47	8.84	0.33	12.83	54.74	4.78	19.95
Compaq Deskpro 386/25	2.36	8.59	0.37	2.53	54.28	5.32	17.04
Amax PC/386-25	2.36	8.55	0.38	16.07	48.35	16.39	41.18
Fountain 386/25	2.36	8.55	0.38	16.06	51.44	11.53	25.71
VIPC 386/25	2.36	8.52	0.38	16.07	42.27	8.91	N/A**
Core ATomizer 386/25	2.31	11.59	0.32	N/A*	60.74	4.14	18.18
CPU 386/25	2.31	8.40	0.29	4.13	85.38	18.12	22.52
Dell System 325	2.31	8.38	0.30	1.55	53.99	5.22	20.05
HP Vectra RS/25c	2.31	8.35	0.30	11.01	66.30	6.28	18.23
Destiny 386-25	2.29	8.37	0.33	16.08	62.94	4.90	17.56
Zeos 386-25	2.29	8.37	0.33	4.15	10.34	6.70	N/A**
Fortron 386 25	2.29	8.35	0.32	4.14	56.00	5.11	17.68
Micro Express 386-25	2.29	8.31	0.32	4.15	62.94	4.87	28.63
Acer 1100/25	2.29	8.29	0.29	1.41	71.57	26.77	22.72
Pacer 386 25	2.27	8.63	0.33	N/A*	51.44	7.56	43.57
Bus 386/25	2.27	8.36	0.31	8.28	9.54	5.55	N/A**
MicroLab 386/25	2.27	8.36	0.31	4.15	56.79	7.03	23.51
IBM PS/2 Model 70-A21	2.27	8.33	0.60	1.66	72.46	6.63	24.68
DataWorld Data 386-25	2.25	8.35	0.33	4.13	63.24	5.03	22.56
Northgate Elegance 386/25	2.24	8.02	0.31	4.99	64.83	3.94	18.95
Everex Step 386/25	2.23	8.07	0.31	4.57	54.51	4.83	14.09
ALR FlexCache 25386	2.20	8.22	0.28	13.59	55.96	5.07	17.91

N/A*—Not applicable: tha tested systam did not includa axtanded mamory.
N/A**—Not applicabla: this machina's hard disk BIOS was not compatible with our tast.

The **80386 Instruction Mix** benchmark tast measures the time it tekes to execute a selected series of processor-intensive tasks. Tha tast program uses 80386 instruction code. Thase instructions are a subset ot the total processor instruction set. The 80386 Instruction Mix implamants a number ot 32-bit operations. In tha 80386 processor these becoma single instructions, wharaas in the 8086 and 80286 versions of the benchmark tast thay ramain multiple instructions.

The **Floating-Point Calculation** benchmark tast measuras processor speed by looping through a series ot floating-point calculations, including multiplication, division, exponentiation, and logarithmic and trigonometric functions. The benchmark program usas the floating-point library included with Microsoft C Compiler 4.0.

The **Conventional Memory** benchmark test allocates 256K ot conventional memory and treats it as e series of 64-byte records. Then, 16,384 random records are read into and written from this mamory. The result shown is the average of tha read and write times.

Tha **Extended Memory** benchmark tast allocates 256K of extended memory and traats it as a series ot 64-byte records. Then, 16,384 random records are raad into and written from this memory. The result shown is tha avarage of tha raad and write timas.

The **DOS File Access** benchmark test measures the throughput rate of the disk being tested. In this case, throughput timas are meesured in terms of how long the disk takas to perform common DOS fila-management functions. Five tasks—fila creation, sequential file write, sequential tila read, random file write, and random fila raad—are timed and tha rasults summed.

The test is carried out for two different types ot filas—small-racord tiles and large-record filas—that are used by common PC applications. Filas created using small records are typically used by database managament programs, and large records are typically used for word processing and spreadshaat files. Loading a DOS program is also simulated by the large-record test.

Tha **BIOS Disk Seek** benchmark tast meesures tha time it takas to do a random seek using the disk's ROM BIOS. The test rasult includas minimal software overheed and may not parallal the manufacturer's claimed average access time. The test program performs 1,000 seeks. The average result is shown in milliseconds.

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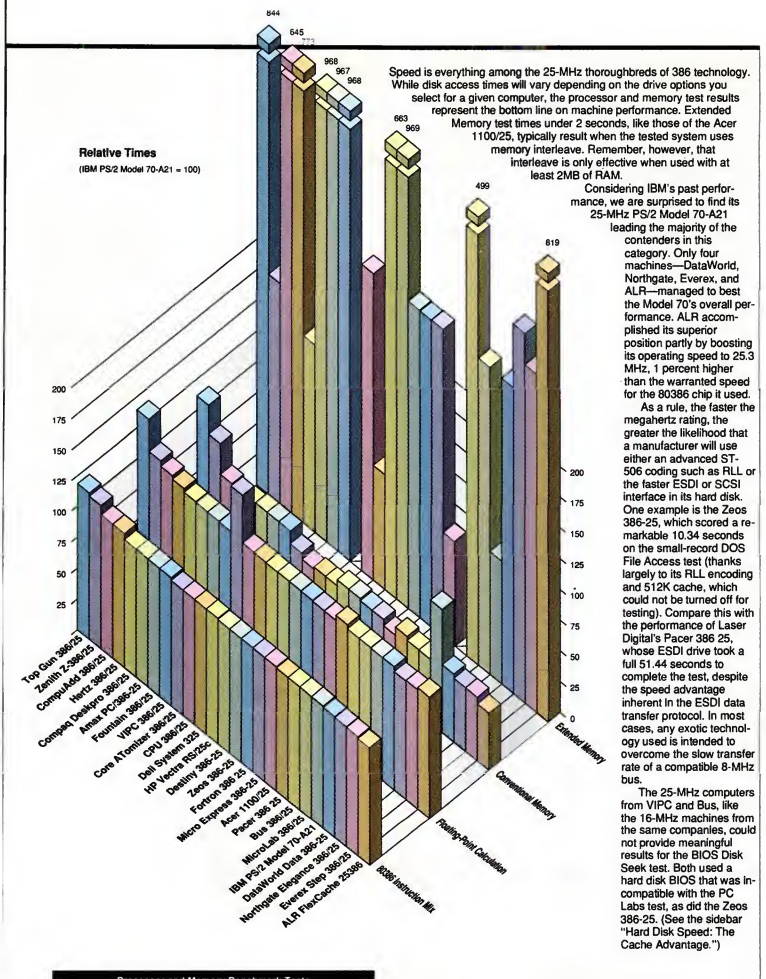

Processor and Memory Benchmark Tests

Speed is everything among the 25-MHz thoroughbreds of 386 technology. While disk access times will vary depending on the drive options you select for a given computer, the processor and memory test results represent the bottom line on machine performance. Extended Memory test times under 2 seconds, like those of the Acer 1100/25, typically result when the tested system uses memory interleave. Remember, however, that interleave is only effective when used with at least 2MB of RAM.

Considering IBM's past performance, we are surprised to find its 25-MHz PS/2 Model 70-A21 leading the majority of the contenders in this category. Only four machines—DataWorld, Northgate, Everex, and ALR—managed to best the Model 70's overall performance. ALR accomplished its superior position partly by boosting its operating speed to 25.3 MHz, 1 percent higher than the warranted speed for the 80386 chip it used.

As a rule, the faster the megahertz rating, the greater the likelihood that a manufacturer will use either an advanced ST-506 coding such as RLL or the faster ESDI or SCSI interface in its hard disk. One example is the Zeos 386-25, which scored a remarkable 10.34 seconds on the small-record DOS File Access test (thanks largely to its RLL encoding and 512K cache, which could not be turned off for testing). Compare this with the performance of Laser Digital's Pacer 386 25, whose ESDI drive took a full 51.44 seconds to complete the test, despite the speed advantage inherent in the ESDI data transfer protocol. In most cases, any exotic technology used is intended to overcome the slow transfer rate of a compatible 8-MHz bus.

The 25-MHz computers from VIPC and Bus, like the 16-MHz machines from the same companies, could not provide meaningful results for the BIOS Disk Seek test. Both used a hard disk BIOS that was incompatible with the PC Labs test, as did the Zeos 386-25. (See the sidebar "Hard Disk Speed: The Cache Advantage.")

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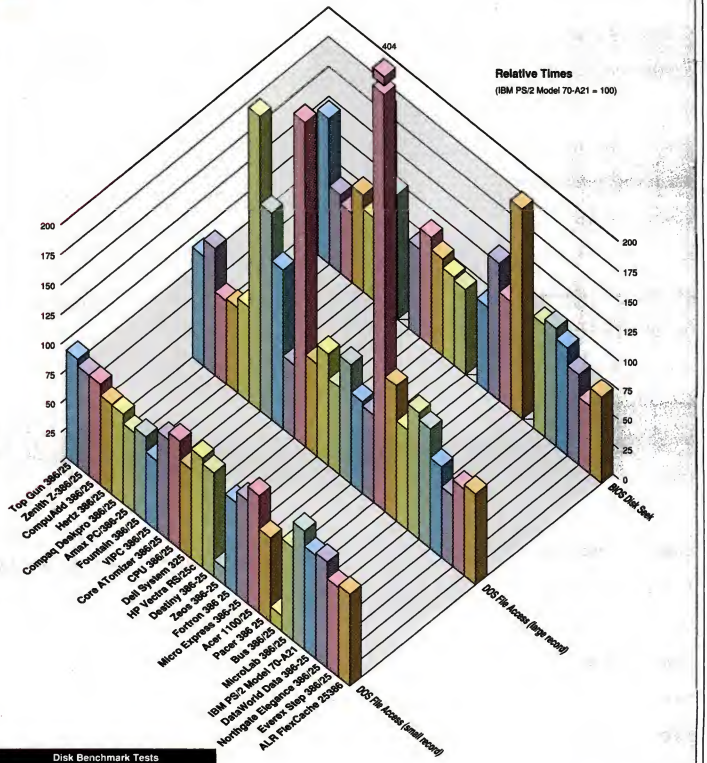
Benchmark Tests: 25-MHz 386 Computers



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Metro 1.1 ..... 59.
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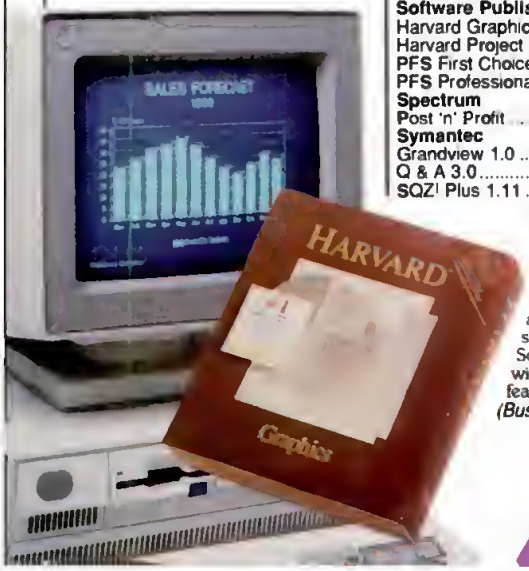

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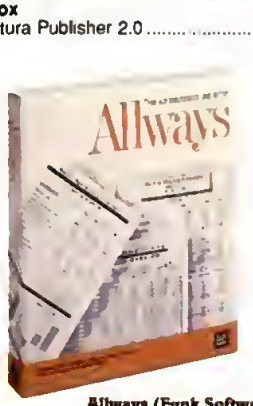

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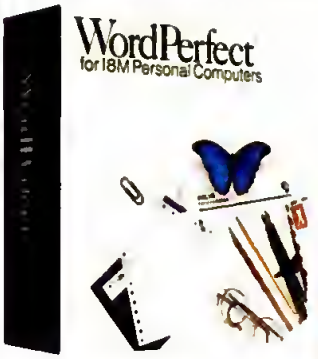

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FOUNTAIN TECHNOLOGIES INC.
FOUNTAIN 386/20
FOUNTAIN 386/25

Some of the less well-known clone vendors offer quality performance, parts, and workmanship at prices that rival the high-end, high-priced systems from top-of-the-line 386 manufacturers. Others come with some worthy features attached to a high price tag, but fall short in vital areas. Fountain's 386 line consists of two such machines.

Fountain's base configurations include 1MB RAM, a 1.2MB floppy disk drive, and parallel, serial, and game ports. The base prices are $2,170 for the 20-MHz machine and $4,030 for the 25-MHz model. The tested 386/20 and 386/25 configurations, with high-performance 150MB Toshiba hard disks, Visualpro VGA monitors, and 1.44MB floppy disk drives, as well as 4MB RAM in the 25-MHz unit, brought the prices up to $5,190 and $8,850, respectively.

Our test units also had a combination floppy/hard disk controller from Omti, capable of driving either standard ST-506 or ESDI hard disks. The brand and type of controller, like most of the other components (right down to the motherboard), vary according to the configuration you select.

OTHER FEATURES Other features of the Fountain 386s are typical of most clones: eight slots, a 200-watt power supply, and five half-height disk bays. Both models also have 101-key keyboards and use Phoenix's ROM BIOS. The BIOS includes a useful setup utility that can be called from the keyboard. Some handy software, including a proprietary expanded memory manager and *QA Plus*, a generic diagnostic and performance benchmark utility program, is thrown in for good measure.

The Fountain systems offered no speed surprises: they performed about as expected for machines of their respective classes. However, several construction flaws are inherent in the two machines. Parts of the casings on both units we received were bent and deformed because of the use of flimsy-gauge metal; the 386/20 even displayed a significant sag across the front, which bent the disk bays out of square.

In each machine, the mounting for the expansion card brackets was loosely riveted to the back panel at just three points. In addition, the power supplies had been poorly fitted; they could move up and down in their mounted positions. To add insult to injury, the fronts of the cases have openings for only two half-height drives, so you'll have to pull out a floppy if you want to add an internal tape drive.

The manual that comes with the 386/25 is based on the same text that accompanies the 386/20. Unfortunately, since both machines use different motherboards, buyers of the 25-MHz machine will find their manuals filled with misinformation. For one thing, the manual tells 25-MHz machine owners that the bus runs at 10 MHz when it in fact runs at 8.33 MHz. Also, the instructions on using the CPU speed-changing utility are completely wrong for the 386/25.

The cheap construction and weak supporting materials overshadow the more minor flaws, including a key lock that is designed so that you cannot remove the key when the machine is unlocked and operating. The fact that the keys are cheap imitations of the IBM cylindrical key (both machines came with keys that had the same serial number, and both could be unlocked by keys from other clones) means the security offered is a sham in any case.

Both the Fountain 386/25 and its 20-MHz sibling provide the requisite 8 slots, 200-watt power supply, and five half-height bays. The base price of the 25-MHz also includes 4MB of RAM. But flimsy-gauge metal casing and poorly fitted power supplies are problems.

The key lock also inconveniently doubles as a reset switch. This concept is potentially dangerous, since users who might choose only to lock their systems can easily turn the key too far, causing the machine to reboot and ruin operations that are in progress.

The bright spots in all this are the Hi-Tek keyboards. Both are quiet but have a rather good, stiff feel. I found the Enhanced-style 101-key layout on the 386/25 a bit nicer to use than the 386/20's standard 101-key configuration, although both could benefit from better keycaps.

Poor quality, incorrect information in skimpy documentation, and an absence of any really outstanding features make these computers less than attractive. You can do better elsewhere.—**Alfred Poor**

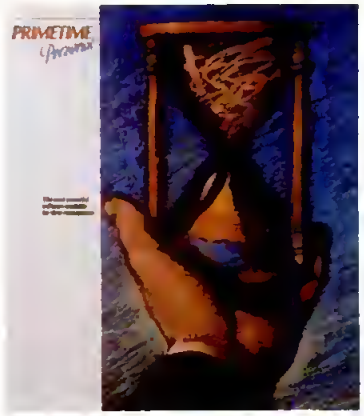
PC MAGAZINE FACT FILE

Fountain Technologies, Inc.
12K World's Fair Dr.
Somerset, NJ 08873
(201) 563-4800

Fountain 386/20
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, $2,170; with 60MB hard disk, monochrome monitor, DOS 3.3, $3,390; with VGA monitor, $4,150; with 2MB RAM, 150MB hard disk, 1.2MB 5¼-inch and 1.44MB 3½-inch floppy disk drives, $5,190. 1MB RAM upgrade, $640; 60MB tape backup, $785.
CIRCLE 631 ON READER SERVICE CARD

Fountain 386/25
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, $4,030; with 60MB hard disk, monochrome monitor, DOS 3.3, $5,250; with VGA monitor, $6,010; with 4MB RAM, 150MB hard disk, 1.2MB 5¼-inch and 1.44MB 3½-inch floppy disk drives, $8,850. 1MB RAM upgrade, $640; 60MB tape backup, $785.
CIRCLE 632 ON READER SERVICE CARD

In Short: The Fountain computers have their minor moments, but the poor attention to detail and less-than-helpful documentation put these machines out of the running for all but the most intrepid and self-sufficient.



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CIRCLE 283 ON READER SERVICE CARD

■ 80386 DESKTOP PCs

GENERAL TECHNOLOGY CORP.
GENTECH 386

From General Technology Corp., a Rhode Island–based mail-order firm, comes the GenTech 386, base priced at $1,799. While it's not the least expensive 386 we've seen, this unit falls comfortably at the low end of the price range.

The GenTech 386 is sold as a 16-MHz computer, but it's really not. For one thing, setting a jumper on CSS's zero-wait-state motherboard lets it run at 20 MHz—if you want to take the chance on pushing the 80386-16 chip. There's probably no reason not to try it this way, but even the conservatives who avoid running it at this speed will find themselves clipping along at a 16-MHz-plus pace.

Instead of using a 32-MHz clock crystal (which yields 16-MHz performance), the GenTech 386 comes with a 34.4-MHz crystal, giving you an uneven and unusual 17.2-MHz clock speed. While this "little boost," as General Technology calls it, certainly shouldn't strain the 80386 processor, the use of a nonstandard, undocumented component is a bit disconcerting.

The motherboard also includes the Award 386 Modular BIOS. Conveniently, you can put 4MB of 32-bit memory right on the BIOS. You can also purchase a memory card that will take 8MB of 100-nanosecond static RAM chips, bringing the total amount of 32-bit RAM to 12MB. If you want to use the full 16MB that DOS and OS/2 can handle, you'll have to rely on 16-bit memory.

The GenTech 386, from General Technology Corp., is sold as a 16-MHz computer, but the use of a 34.4-MHz clock crystal boosts its speed to 17.2 MHz. Beyond that, you can set a jumper on the zero-wait-state motherboard to run the machine at 20 MHz.

FLOUTING THE STANDARDS The expansion bus speed is set at 8.58 MHz in normal operating mode. (With the machine set to 20 MHz, the bus runs at 10 MHz.) The 8.58 speed is another slightly off-standard number; it's probably okay in most situations, but if you're using older AT cards, this machine might not be able to handle them.

The base price includes 1MB of RAM, a Western Digital hard/floppy disk drive controller, a 1.2MB floppy disk drive, and two serial and two parallel ports. The standard keyboard is a Chicony unit with the usual Enhanced-style keyboard and an okay feel. The 16-MHz test configuration added a 40MB 28-millisecond MiniScribe hard disk, an 8-bit VGA card made by the little-known NSI Logic, and a VGA monitor from the equally unknown Imtec. The inclusion of some off-brand parts assuredly helps keep the list price of the test unit at an attainable $3,053.

PC MAGAZINE FACT FILE

GenTech 386
General Technology Corp.
205 Hallene Rd.
Warwick, RI 02886
(401) 732-5556
(800) 543-4302
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, $1,799; with 40MB hard disk, monochrome monitor, DOS 3.3, $2,425; with VGA monitor, $2,850. 70MB hard disk, $599; 90MB SCSI hard disk, $859; 155MB ESDI hard disk, $1,335; 1MB RAM, $450.
In Short: Sold as a 16-MHz machine, the GenTech 386 actually operates at 17.2 MHz or, by changing a jumper, at 20 MHz. The components are passable and the price is very good, but lack of FCC approval may prevent the manufacturer from selling this machine.

CIRCLE 545 ON READER SERVICE CARD

AST Takes 33 MHz, 386™ Power One Step Further.

From left to right:
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25 MHz, AST Premium 386/25
20 MHz, AST Premium/386C
16 MHz, AST Premium 386/16
16 MHz, AST Premium Workstation/386SX

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AST Premium 386/33	AST Premium 386/25	AST Premium /386C	AST Premium 386/16	AST Premium Workstation /386SX
51.7	39.4	30.8	23.3	23.2

Landmark Software v. 1.1 benchmarks — a generalized index used to compare one machine to another. The higher the number, the better

As a result, you'll be able to tackle a broad range of performance-sensitive and power-hungry applications both in single and multiuser environments, such as 3-D animation, geophysical simulation, regression analysis, CAD/CAM and LAN file service.

And like the rest of the AST 386 family, the AST Premium 386/33 is backed by the same commitment to quality, industry-standard compatibility and support that makes AST a computer industry leader.

Of course, if you don't need quite so much power, AST offers several high-performance 386 and 386SX™ systems. Such as the 25 MHz, AST Premium 386/25 and the 20 MHz, AST Premium/386C for racing through technical and business applications.

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One very negative note is that, as of this writing, this machine has not yet received FCC approval, even for Class A use. According to General Technology, that approval is pending.

General Technology's use of some nonstandard components and off-brand names isn't necessarily bad, but that combined with the lack of FCC approval for this machine is enough to make us hesitate. **—Bruce Brown**

HERTZ COMPUTER CORP.
HERTZ 386/16
HERTZ 386/25

Hertz aims its products at the value-added-reseller market and large corporate clients; reliability and quality are its sales tools. The two 386 machines we received—the 386/16, base priced at $2,695, and the higher-speed, $4,959 386/25—exemplify the company's commitment to engineering dependable, if not lightning-fast, systems.

Intel, an industry leader if ever there was one, makes not only the chips and the motherboard, but also the power supply and chassis. The BIOS is from the ever-capable Phoenix, and equally reputable companies supply most of the other components.

The Intel motherboards are eight layers deep, large enough to accommodate the esoteric logic that the manufacturers of motherboards with fewer layers must leave out. Although most commercial programs do not require this logic, its presence gives value-added resellers the opportunity to write software that makes use of it. It also means that these systems will run anything ever written for the 386 processor.

Speed is a secondary consideration for these machines, so it's no surprise that neither really shone on our benchmark tests: the 16-MHz unit compared more favorably to those in its class but had noticeably low scores on the Conventional and Extended Memory tests. The 386/25's test system scored poorly on the processor tests, but its ESDI Western Digital controller and 330MB Micropolis hard disk helped it do better in the File Access tests.

Both machines are roomy enough for the standard five half-height bays and a 220-watt power supply with five connectors. In addition to the 2MB of RAM, controller, 1.2MB 5¼-inch floppy disk drive, and one parallel and two serial ports included in the base price, the systems we received each sported a 1.44MB 3½-inch floppy disk drive, a Hertz multiscanning monitor, and Video Seven's 16-bit VGA card, as well as Hertz's own keyboard, which gives you good, crisp feedback.

HERTZ 386/16 The 16-MHz 386, at 16½ by 21 by 6½ inches (HDW), is about the same size as a PC AT; the strong metal case helps it earn an FCC Class B rating. On the 386/16 as well as the 386/25, power and disk access are indicated by LEDs on the front panel; there are no buttons to reset the machines, and switching to 8 MHz can be accomplished only through software.

The zero-wait-state 386/16 comes standard with the maximum 2MB of 100-nanosecond RAM in SIMM packs on the motherboard and eight expansion slots, two of which can accommodate either 2MB or 8MB 32-bit memory boards. Four 16-bit slots also come standard; in the $4,495 system we received, one of these slots was filled with a Western Digital modified-frequency-modulation (MFM) controller for the 72MB Micropolis hard disk. Two additional slots were taken up by the video board and parallel and serial ports, leaving one 16-bit and two 8-bit slots available for further expansion.

The Intel name graces not only the chips and the motherboard, but also the power supply and chassis of the Hertz 386/25 and the 386/16. An eight-layer motherboard accommodates the esoteric logic that manufacturers of motherboards with fewer layers must leave out.

HERTZ 386/25 The 386/25, also a Class B-certified machine, is 2 inches deeper and slightly more rigid than the 386/16. The motherboard on the zero-wait-state unit nearly mirrors that found on the 16-MHz machine, except that it offers an additional serial port and can pack up to 8MB of RAM. With 5MB RAM, the price of the tested system rose to $10,470.

The slot configuration differs a bit from the 386/16: with the 25-MHz machine, you get the 32-bit slots, as well as one 8-bit

PC MAGAZINE FACT FILE

Hertz Computer Corp.
325 Fifth Ave.
New York, NY 10016
(212) 684-4141

Hertz 386/16
List Price: With 2MB RAM, 1.2MB 5¼-inch floppy disk drive, $2,695; with 40MB hard disk, monochrome monitor, DOS 3.3, $3,395; with VGA monitor, $3,995; with 2MB RAM, 70MB hard disk, 1.2MB 5¼-inch and 1.44MB 3½-inch floppy disk drives, $4,495. 1MB RAM upgrade, $475; 150MB hard disk, $1,395; 60MB tape backup, $750.

CIRCLE **546** ON READER SERVICE CARD

Hertz 386/25
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, $4,995; with 40MB hard disk, monochrome monitor, DOS 3.3, $5,495; with VGA monitor, $5,995; with 4MB RAM, 330MB hard disk, 1.2MB 5¼-inch and 1.44MB 3½-inch floppy disk drives, $9,995. 1MB RAM upgrade, $475; 60MB tape backup, $750.

CIRCLE **547** ON READER SERVICE CARD

In Short: The Hertz 16- and 25-MHz machines are ones to look at if your priorities are dependability and reliability rather than blinding speed. Their Intel motherboards are eight layers deep, large enough to give value-added resellers the opportunity to write software for them. Also, it means that these systems will run anything ever written for the 386 processor.

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Customer Profile

Regis McKenna

Age: Old enough to remember the day that Intel Corporation was founded.

Profession: Chairman of Regis McKenna Inc., a major marketing company based in "Silicon Valley." A general partner in the venture capital firm of Kleiner Perkins Caufield & Beyers. Author of the *Regis Touch* and most recently, *Who's Afraid of Big Blue?**

Hobbies: Enjoys doing extensive research on innovative new technologies. He recently became involved in building and archiving an extensive database, using state-of-the-art page recognition software.

His Page Recognition Software: *OmniPage* of course. According to Regis: "*OmniPage* represents one of the most complete page recognition software products; providing incredible flexibility to customize data which can be easily accessed later. All of a sudden the cost of archiving and retrieving data has dropped significantly. The 'Information Age' is upon us and we have an exciting new tool."

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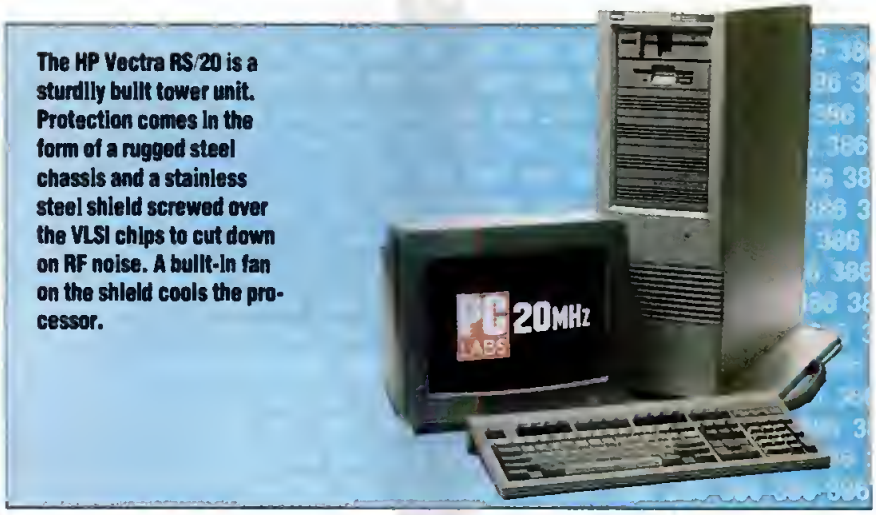
CIRCLE 292 ON READER SERVICE CARD

and five 16-bit slots, obviously a preferable combination. A few additional perks—like a real-time CMOS clock chip with an integral lithium battery, room for 24MB of RAM, and 64K of fast cache memory using 35-ns. chips—are also included with this machine.

The 386 chip on this system also has a heat-sink positioned above it and an extra fan for more cooling capacity. These provisions for greater cooling capacity are necessary for anyone who has the full 24MB of RAM operating at 25 MHz. Like the extra-rigid chassis, the extra fan will increase the longevity of the machine, especially in hostile environments.

The price of the 25-MHz unit also includes on-site support service from Intel. An on-site contract can be bought for the 16-MHz model for prices ranging from $325 to $600. Overall, the Hertz machines are ones to look at if your priorities are dependability and reliability rather than blinding speed.—**Kate Emery**



The HP Vectra RS/20 is a sturdily built tower unit. Protection comes in the form of a rugged steel chassis and a stainless steel shield screwed over the VLSI chips to cut down on RF noise. A built-in fan on the shield cools the processor.

HEWLETT-PACKARD CORP.

HP VECTRA QS/16
HP VECTRA RS/20
HP VECTRA RS/25C

Hewlett-Packard has been in the personal computer business since 1983. It wasn't until the 1985 introduction of the IBM-compatible Vectra PC, however, that the company really began to make a name for itself in the PC systems arena. Three years later, a new family of high-end, 386-based Vectras was introduced: the QS/16, the RS/20, and the RS/25c. Each machine demonstrates HP's workmanship and dependability while offering cutting-edge performance.

The Vectra QS/16 is a small-footprint 386 that packs a lot of punch into a little box. The extremely sturdy system unit measures 6½ by 16¾ by 15½ inches, making it slightly larger than a PS/2 Model 70 but still a considerable space-saver. Like the other 386 HP Vectras, the QS/16 features a power switch on the front of the unit, along with a power-on light, disk activity indicator, and cylindrical keyboard lock.

TWO TOWER UNITS The Vectra RS/20 and RS/25c (the "c" stands for caching) are tower units with molded plastic casings that have a slick, refined look. Under the cover is a rugged steel chassis conveniently engineered for easy access to the components. For additional security, both RS units have system cover locks on the back of their monitors.

An HP Enhanced-style keyboard accompanied each test unit. The keyboard had smaller-than-normal key caps on normal-sized keys; although the difference may take a while to get used to, the keyboard has a pleasant feel. Audible key clicks can be enabled or disabled from the keyboard, and the extra-long keyboard cable (8 feet) is a nice feature.

Our QS/16 evaluation unit also came equipped with a 1.2MB 5¼-inch floppy disk drive, 40MB hard disk, Western Digital ST-506 controller, and 2MB RAM, bringing the total cost of the system to $6,765. The three available drive bays limit your expansion capabilities to three internal devices; a tape backup is the obvious choice to fill the system's third accessible drive bay. Appropriately, the 220-watt power supply has only three device connectors.

The RS/20 sent to PC Labs included 1.2MB and 1.44MB floppy disk drives, a 103MB hard disk and controller, and an 80387 coprocessor for a total cost of $9,610. Our RS/25c test unit came with a 25-MHz 80387 coprocessor, two floppy disk drives, and a 155MB ESDI hard disk. The price of that configuration came to $14,315—not the most expensive machine in this roundup, but close.

Each RS unit has six accessible half-height drive bays. The 230-watt power supply with five device connectors will suffice for nearly everyone's internal drive needs. To help fill those bays, HP offers a variety of high-capacity, high-speed disk drives ranging from 40- to 310MB. Those over 40MB are 17-millisecond ESDI drives manufactured by HP and low-level-formatted at the factory. You pay a hefty price for HP hard disks if you buy them separately (the 103MB drive, for example, is $2,995), but you get top quality and blazing disk speed.

HP-MADE MOTHERBOARD Hewlett-Packard makes the motherboard for all the RS systems; the 16-MHz machine's ROM BIOS version D.02.00 QS/16 is a customized version of Phoenix Technologies' latest BIOS. The ROM BIOS versions E.02.00 RS/20 and E.02.00 RS/25c found in the RS models are also customized renditions of the Phoenix BIOS.

One 8-bit slot, six 16-bit AT-style slots, and one proprietary 32-bit slot are available on the QS/16's motherboard. A tiny expansion slot next to the power supply in all the Vectras comes filled with the HP-HIL (Human Interface Link) board, used for connecting HP input devices like touch-pads and mice. The QS/16's 32-bit processor/memory card held a 16 MHz 80386 processor and 2MB of 100-nanosecond DRAMs (although 1MB is standard). This modular-design card makes it

FACT FILE

Hewlett-Packard Corp.
974 E. Arques Ave.
P.O. Box 486
Sunnyvale, CA 94086
(800) 752-0900
(408) 973-1919

HP Vectra QS/16
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, $3,995; with 40MB hard disk, VGA monochrome monitor, DOS 3.3, $5,865; with VGA monitor, $6,310; with 2MB RAM, $6,960. 1MB RAM upgrade, $650; 40MB tape backup, $795.
CIRCLE 548 ON READER SERVICE CARD

HP Vectra RS/20
List Price: With 1MB RAM, 103MB hard disk, 1.2MB 5¼-inch floppy disk drive, $7,595; with 103MB hard disk, VGA monochrome monitor, DOS 3.3, $8,400; with VGA monitor, $9,080; with 2MB RAM, 1.2MB 5¼-inch and 1.44MB 3½-inch floppy disk drives, $9,875. 1MB RAM upgrade, $795.
CIRCLE 549 ON READER SERVICE CARD

HP Vectra RS/25c
List Price: With 1MB RAM, 103MB hard disk, 1.2MB 5¼-inch floppy disk drive, $10,295; with 103MB hard disk, VGA monochrome monitor, DOS 3.3, $11,110; with VGA monitor, $11,780; with 4MB RAM, 155MB hard disk, 1.2MB 5¼-inch and 1.44MB 3½-inch floppy disk drives, $13,175. 1MB RAM upgrade, $795; 40MB tape backup, $795.
CIRCLE 550 ON READER SERVICE CARD

In Short: Built for the duration, the Vectra QS/16, RS/20, and RS/25c are engineering marvels. From the sturdy chassis to the rock-solid keyboard, these machines are designed to take you into the next century. In comparison with other 386s, you pay top dollar for the Vectras but get superior quality and break-neck performance in return.

very easy to install more memory or a co-processor—no more messing around with your head buried inside your PC. While no cache controller is supported in the QS/16, zero-wait-state operation is made possible by page-mode memory.

Both RS systems have two 8-bit and six 16-bit slots along with the 32-bit processor/memory slot. The processor/memory card in the RSs is actually a parent card with a permanent daughterboard attached. It's conveniently located at the very bottom of the unit for easy removal and installation and to help keep those chips cool. On all the Vectras, a stainless-steel shield is screwed down over the VLSI chips for protection against extra RF noise. The shields on both RS models also have fans built in directly over the 80386 20- and 25-MHz chips, and another fan is located at the front base of the units. It's obvious that HP went out of its way to meet (and even outdo) the stringent FCC Class B standards.

One megabyte of 100-ns. 256-kilobit SIMM modules comes standard in the RS/20, although the evaluation unit had 2MB. The RS/25c workhorse comes standard with 1MB of 80-ns. DRAMs in 1-megabit SIMMs, but our evaluation unit had 4MB. Both the RS models and the QS/16 are expandable to 16MB.

Both RS processor/memory cards support an Intel or Weitek coprocessor and an Intel 82385 cache controller rated at their respective speeds (20 or 25 MHz). The cache controller uses 32K of 25-ns. static RAM to achieve zero-wait-state operation.

A disk-based setup program allows all three Vectras to shadow the system and video BIOS in a 384K chunk of RAM. An HPCACHE program supplied with each system allows you to set up a disk cache area of up to 1MB in base, expanded, or extended memory. Also included is an expanded memory manager that lets you emulate expanded memory with the RAM that you loaded onto your system.

No, none of these new Vectra systems is cheap. But their superior engineering and top-shelf performance could easily convince you that they're worth the price.
—Greg Alwang

HiTech International Inc.
HITECH SAM 3001/386

What do you think about HiTech International's $1,295 base price for its SAM 3001/386 machine with 1MB of RAM, a Western Digital hard/floppy disk controller, a 1.2MB 5¼-inch floppy disk drive, one parallel and two serial ports, a 230-watt power supply, and DOS? Well if you like that, how about that same system with

The very low price of the HiTech SAM 3001/386 with a Seagate 43MB hard disk drive, VGA adapter and monitor, and 2MB of RAM can't be beat. The unit lacks cache RAM and memory interleaving but still manages decent speed.

an additional megabyte of RAM, a Seagate 40-millisecond 43MB hard disk, an 8-bit VGA adapter, a VGA monitor, *and* an 80287 math coprocessor—all for $2,895?

We're not talking 386SX, either. The SAM 3001 has an honest-to-goodness Intel 80386-16 chip—real 32-bit goods. The motherboard is by American Digicom (under license from Micronics), one of the standards in the business; the BIOS is Award's. The standard 2MB memory card uses 100-nanosecond, static-column 256-kilobit DRAM chips, but you can install 8MB worth of 1-megabit chips on each of two 32-bit memory cards to get 16MB.

The unit isn't equipped with the fastest coprocessor in the world. But if you really want a top-of-the-line math coprocessor, Compaq will sell you a Weitek for $2,599, suspiciously close to the price of the tested SAM 3001 system. If you can't live with the 8-bit VGA adapter, you can replace it with a faster VGA system.

And yes, the hard disk is *only* a 43MB, 40-ms. Seagate ST-251, the kind almost everyone puts into AT clones. But here's a simple trick that quickens its pulse rate: instead of partitioning it as one drive, divide it into two roughly 20MB partitions. Lo and behold, 28-ms. performance with a 40-ms. drive!

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CIRCLE 266 ON READER SERVICE CARD

MODEST SPECS, GOOD SPEED The SAM 3001 runs its expansion bus at a safe 8 MHz, so go ahead and add AT-compatible cards without worry. If you really need to slow down, simultaneously hit the Ctrl-Alt-Minus keys to cycle CPU speed to 8 or 6 MHz. There isn't any cache memory or even memory interleaving, though you can shadow the video and BIOS ROM, blocking off the top 384K of RAM. The system runs constantly with one wait state to avoid outrunning the 100-ns. chips. Funny thing, though—even with these modest specs, the SAM unit scores pretty well, landing in the middle of the 16-MHz pack on the PC Labs benchmark tests.

The keyboard is an unresponsive Key Tronics 101-key enhanced unit. So if you'd like some liveliness, put this one on the shelf and buy a replacement. That's the only change I'd make if I bought one of these systems.

The only real drawback is a more limited warranty policy than you get from most other mail-order vendors. HiTech International warrantees everything but the hard disks for a year; the hard disks get only 90 days. HiTech also won't pay for shipping sickly systems either to or from its San Jose, California location. On the other hand, it does offer a 30-day money-back guarantee—the mail-order dealer's credibility move.

Some people may say that if the SAM 3001 can meet your needs, you don't really need a 386; a 286 might serve you just fine. But golly, a real 386 that performs pretty well for just a few hundred dollars more than an AT compatible? Why not go for it?—**Bruce Brown**

PC MAGAZINE FACT FILE

HiTech SAM 3001/386
HiTech International Inc.
712 Charcot Ave.
San Jose, CA 95131
(408) 435-8827
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, $1,295; with 60MB hard disk, monochrome monitor, DOS 3.3, $1,895; with VGA monitor, $2,650; with 2MB RAM, 43MB hard disk, 80287-10 coprocessor, $2,895.
In Short: Dollar conscious? Look here. Unfortunately stingy warranty policies, but maybe that's why they can price these standard components so cheaply.
CIRCLE 642 ON READER SERVICE CARD

IBM CORP.

IBM PS/2 MODEL 70-E61
IBM PS/2 MODEL 70-121
IBM PS/2 MODEL 70-A21

Tailored to a mere 5½ by 14 by 16½ inches (HWD), IBM's PS/2 Model 70 machines are living proof that power doesn't have to come packaged inside a huge case. The 70-E61, 70-121, and 70-A21 systems may be a little short on drive and slot space, but you do get fast 386 processors, room for plenty of memory, and lots of standard features in boxes that won't eat up your desk space.

The Micro Channel–based, small-footprint machines range from a $5,995 base price for the 16-MHz 70-E61 to $7,995 for the 20-MHz 70-121 to $11,295 for the 25-MHz 70-A21. In the E61, that price includes 1MB of RAM and a 60MB hard disk; the RAM and storage space are doubled in the 121 and A21 systems. Other standard components in each unit include one parallel and one serial port, a mouse port, a 3½-inch 1.44MB floppy disk drive, a built-in VGA adapter, a 132-watt power supply, and three expansion slots—two 32-bit and one 16-bit. All three slots are empty and available in the standard units.

IBM makes everything in these computers: motherboard, BIOS, floppy and hard disk drives, controllers, video adapters, and monitors. The only non-IBM label is on the Intel processor chips.

The Model 70s weigh in at 21 pounds each, including the standard 101-key Enhanced-style keyboards. You may quibble with the key arrangement, but it's hard to argue with the feel, even though IBM has backed off a bit from the clicky responsiveness of its original XT and AT keyboards.

PS/2 MODEL 70-E61 The 1MB of 100-nanosecond RAM that comes standard is located in SIMM packs on the motherboard, which can accommodate up to 6MB. Thirty-two-bit system memory can be brought up to 16MB by adding 10MB more onto a memory expansion card.

The E61 doesn't use shadow or cache memory, but speed is helped by the interleaved RAM. The default is zero wait states, but you can adjust that to two wait states by changing the interleaving factor with software. On this system, as well as on the other models, the expansion bus runs at a straight 10 MHz.

Although there was no math coprocessor in the test unit, the E61 will accept an 80387 chip. Our test configuration included all the standard equipment, as well as an extra megabyte of RAM and an 8513 VGA monitor. With DOS 4.01 (IBM no longer sells DOS 3.3), the price of the configured system rose to $7,690.

A look at the E61's scores on the PC Labs benchmark tests reveals roughly average times in its class of 16-MHz 386 machines, with stronger performance in the Extended Memory and DOS File Access (large-record) tests.

PS/2 MODEL 70-121 The faster 20-MHz 70-121 is similar to the 16-MHz E61 in many respects: it uses the same motherboard, defaults to zero wait states, and

Nearly everything on the three versions of the small-footprint IBM PS/2 Model 70 is IBM-made. The 25-MHz PS/2 Model 70-A21 has an Intel cache controller and 64K of 30-nanosecond cache RAM to help it achieve top memory benchmark scores.

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ALR'S MICROFLEX 7000: EVERYTHING YOU WANTED IN THE MODEL 80

When IBM constructed its first 25-MHz computer, the PS/2 Model 70 8570-A21, the company squeezed the components into a desktop case with only three expansion slots. Whatever happened to the floor-standing, 8-slot, 25-MHz powerhouse that everyone expected to see as a successor to the floor-standing 20-MHz PS/2 Model 80-311?

At the time of this writing, IBM hadn't announced any new 25-MHz machines. But Advanced Logic Research was showing off its own version of what such a machine might look like.

The ALR MicroFlex 7000 is the first floor-standing 25-MHz computer to use IBM's Micro Channel architecture (MCA). Until now, the very few MCA clones released have been Model 70–style desktops, like Tandy's five-slot 5000MC, and similar machines available only in Europe. ALR's MCA motherboard sports eight expansion slots: three 32-bit and five 16-bit. Like IBM's Micro Channel computers, ALR puts VGA on the motherboard, but ALR goes beyond IBM's 640 by 480 VGA resolution to the new Super VGA standard of 800 by 600.

MORE IMPROVEMENTS Like IBM, ALR puts 2MB of 32-bit, 80-nanosecond RAM on the motherboard; you can increase memory to 16MB by installing the same kind of SIMMs that IBM uses. Also like IBM, ALR puts 64K of cache memory on the motherboard and controls it with the Intel 82385—but ALR supplements this with an advanced version of its proprietary cache-control circuitry. ALR also supports the 80387 coprocessor, but lets you install a Weitek chip as well.

When the MicroFlex 7000 hits the streets, you'll be able to buy it in two configurations. The $9,499 Model 120A21 (prices are subject to change by the time the product is released) sports a 120MB ESDI hard disk drive and a controller that includes a 32K hardware disk cache—something IBM doesn't offer. The $14,750 Model 300A21 is identical except for a 300MB ESDI hard disk. Both machines include a 1.44MB 3½-inch floppy disk drive and IBM-compatible serial, parallel, and mouse ports on the motherboard.

ALR's tower case looks like a less-well-finished version of IBM's case for the Model 80. On a flimsy-looking top panel, ALR has added a brightly flashing LED display that gives you a graphic indication of the rate of "hits" achieved by the hardware cache.

As audio manufacturers discovered when they started putting them on stereo amplifiers, flashing LEDs are boffo in the salesroom. But when you get them back to the office, you find that the fascination quickly wears off—and they're distracting. A few computers used by *PC Magazine* editors have similar displays, and in nearly every case the high-tech LEDs are covered by a low-tech Post-it note.

ONE HITCH, ONE MYSTERY Cloning the MCA turns out to be trickier than cloning the classic AT bus. The unfinished test sample of the MicroFlex 7000 that ALR sent to PC Labs didn't work with IBM's 8514/A video adapter, the only available expansion card that uses the special video extension on one of the Micro Channel slots. ALR promises to fix this problem before releasing the computer for sale.

One mystery still to be resolved is whether Micro Channel clones can be upgraded in the way IBM's Micro Channel machines apparently can be. Recently IBM revealed that existing MCA motherboards have unused circuitry that can be "awakened" with a forthcoming hardware upgrade. IBM promises improved performance for all its existing MCA machines.

Can MCA clones make use of a similar upgrade? That's the $9,499 question raised by ALR's MicroFlex 7000.

—Edward Mendelson

FACT FILE

ALR MicroFlex 7000
Advanced Logic Research Inc.
9401 Jeronimo Rd.
Irvine, CA 92718
(714) 581-6770
(800) 444-4257
List Price: Model 120A21, $9,499; Model 300A21, $14,750 (prices not yet finalized).

CIRCLE 410 ON READER SERVICE CARD

does not support shadow or cache memory. While the system will accommodate the same amount of RAM (divided in the same manner between the motherboard and 32-bit add-in card), the memory chips are rated at a faster 85-ns. to keep up with the 20-MHz clock.

Unlike its 16-MHz sibling, the test configuration came with with the addition of an 80387 coprocessor. Adding on a VGA monitor and DOS brought the list price up to $9,540.

The 70-121 is a moderate performer in the 20-MHz 386 group; its only outstanding performance was in our Extended Memory benchmark tests. Even so, the performance jump over the 16-MHz E61, as well as the extra megabyte of memory and additional hard disk space that come standard, make the 121 worth the extra $2,000, if you have it.

IBM PS/2 MODEL 70-A21 At a base price of $11,295, IBM's flagship 25-MHz machine is $3,300 more than the 20-MHz 121 base unit. For the extra money, you get a motherboard that can take up to 8MB

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- 32-bit high speed RAM board with 1MB RAM axpands to 16MB (384KB reserved)
- System and option ROM shadowing
- ROM-based setup
- Six 16-bit and ona 8-bit expansion slots
- Meth coprocassor support for 80387 or Weitek
- 23.0 on Norton's SI Benchmark 4.0 test

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386/20 System	MGA	EGA	VGA
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80MB	$3,095	$3,445	$3,645

CompuAdd 286/20

- 80286 processor running at 20MHz or 8MHz switcheble system speeds
- 0 weit state (four-wey interleeve)
- 1MB RAM expandabla to 5MB (384KB reserved)
- ROM-based setup
- Six 16-bit end two 8-bit expansion slots
- 80287 math coprocessor support
- 20.4 on Norton's SI Benchmark 4.0 test
  (22.5 rating with 2MB memory and four-way interlaave)

$1695

286/20 System	MGA	EGA	VGA
40MB	$2,249	$2,599	$2,799
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- ROM-besed setup
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- 80287 math coprocessor support
- 16.0 on Norton's SI Benchmerk 4.0 test
  (18.0 reting with 2MB mamory and four-way intarleave)

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- Six 16-bit and two 8-bit expansion slots
- 80287 math coprocessor support
- Choice of enhanced 101-key, AT-style, or 5151 keyboard
- 13.7 on Norton's SI Benchmark 4.0 test

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40MB	$1,579	$1,879	$2,079

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- Six 16-bit and two 8-bit expansion slots
- 80287 math coprocessor support
- Choice of enhanced 101-key, AT-style, or 5151 keyboard
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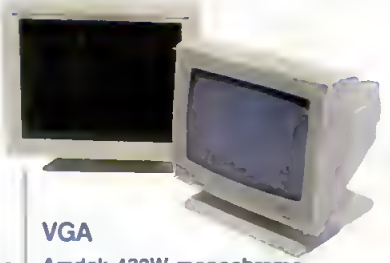

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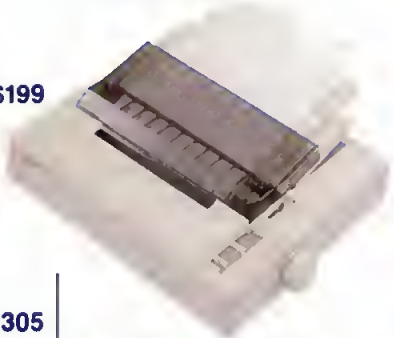

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CompuAdd CORPORATION

of 32-bit RAM directly and can accommodate 8MB more on a card that plugs right into it; this way, you don't have to take up a conventional expansion slot.

Unlike the other Model 70s, the A21 doesn't use memory interleaving. It doesn't have to, though, since it has an Intel 82385 cache controller with 64K of 30-ns. cache memory.

Our test machine had the standard RAM and hard disk configuration. With a VGA monitor, DOS, and an 80387-25 coprocessor, the list price came to $12,925.

The A21 screamed along with the fastest 25-MHz machines in our memory and processor benchmark tests. Drive performance scores were consistent with those achieved by the 20-MHz Model 70, and a little below average for a 25-MHz machine.

PC MAGAZINE FACT FILE

IBM Corp.
Contact your nearest authorized IBM dealer.
(800) IBM-2468

IBM PS/2 Model 70-E6t
List Price: With 1MB RAM, 60MB hard disk, 1.44MB 3½-inch floppy disk drive, $5,995; with monochrome monitor, DOS 4.01, $6,420; with VGA monitor, $6,895; with 2MB RAM, $7,690.
CIRCLE 638 ON READER SERVICE CARD

IBM PS/2 Model 70-121
List Price: With 2MB RAM, 120MB hard disk, 1.44MB 3½-inch floppy disk drive, $7,995; with monochrome monitor, DOS 4.01, $8,420; with VGA monitor, $8,895; with 80387-16 coprocessor, $9,540.
CIRCLE 639 ON READER SERVICE CARD

EDITOR'S CHOICE

IBM PS/2 Model 70-A21
List Price: With 2MB, 120MB hard disk, 1.44MB 3½-inch floppy disk drive, $11,295; with monochrome monitor, DOS 4.01, $11,720; with VGA monitor, $12,195; with 80387-25 coprocessor, $12,925.
CIRCLE 640 ON READER SERVICE CARD

In Short: IBM's PS/2 Model 70s combine small size, impressive modular design, and gobs of power in three pricey computers. You can't expand these computers much, but they come fully equipped anyway. Choose your weapon and enter the power-user wars. If you believe in Micro Channel architecture, these computers are very tempting.

That's something to consider, largely because of the major price difference between the two systems. It makes sense to spring over $11,000 for the A21 only if you must have the highest performance in the areas in which it excels; otherwise, the decently performing 121 should do nicely.

There are some other factors to consider before plunking down your dollars for any of these machines. For instance, you should be sure that the size of the hard disk drives you get will be enough to cover your needs for some time, since you can't install any additional hard disk drives. You also can't add an internal tape backup system to a Model 70.

Secondly, the Model 70s don't make good file servers because they are limited by having only three expansion slots in each system. Speaking of expansion slots, you probably already know that MCA-compatible slots won't accept "normal" AT- or XT-compatible interface cards. MCA-style cards, while on the increase, are still relatively few in number. Better make sure that any extra interface cards you may need to add are available.

A SPACIOUS OPTION Of course, IBM does have an alternative for anyone who needs more drives or expansion space than the Model 70 dynamos can provide. The $10,995 base price of the 20-MHz Model 80-111 386 system includes 2MB of RAM and a 115MB hard disk.

The Model 80 can take an additional 3½-inch drive as well as a full-height, 5¼-inch add-on drive. The system also accepts an internal tape drive.

Built into the system board are a parallel port, serial port, mouse port, floppy disk controller, and VGA circuitry. You get eight MCA expansion slots—three 32-bit and five 16-bit; in the standard configuration, only one of them is taken up by the ESDI hard disk controller.

The Model 80-111 doesn't use a memory cache controller but does use interleaved memory, a performance improvement that our benchmark tests don't take into account. This system performs about on a par with the 20-MHz Model 70-121 but is blown off the map by the Model 70-A21 with its 25-MHz processor and cache memory.

If you want the extra space and Micro Channel architecture and you have to stick with the Big Blue label, the Model 80-111 is the way to go. But if you've ever considered purchasing a high-speed "laptop" to serve as your sole desktop machine, the combination of power and small size in the Model 70s—particularly apparent in the 70-121—makes them perfect alternatives.
—Bruce Brown

LASER DIGITAL INC.
PACER 386 20
PACER 386 25

A look at the identical cases of the Laser Digital Pacer 386 20 (base priced at $1,961) and Pacer 386 25 ($3,500) may give rise to a feeling of déjà vu. From the outside, these boxes could pass for many other 386 clones. A closer look reveals that the similarities are more than skin deep, yet these machines also have some features (not all admirable) that set them apart.

The Laser Digital computers offer fairly solid construction; the chassis are made of a heavier-gauge steel than systems from some other manufacturers. There are substantial shields around the two disk bays,

Laser Digital's Pacer 386 25, like its 20-MHz twin, offers solid construction, courtesy of the heavy-gauge steel. Substantial shields surround the disk bays, which offer room for five half-height devices.

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CIRCLE 476 ON READER SERVICE CARD

which offer room for five half-height devices.

The cases, however, offer access to only two of the five drive bays. In these days of 5¼- and 3½-inch floppy disks, removable hard disks, CD-ROMs, and streaming tape backup devices, two open bays is just not enough. Most units allow easy access to at least three bays.

The Laser Digital motherboard on the 20-MHz model and the American Megatrends (AMI) motherboard (popular with so many clone manufacturers) on the 25-MHz unit offer eight slots each. Additionally, each system has cutouts in the back for I/O port connectors. On both test machines, these cutouts were taken up by one parallel and two serial connectors. The surprise came when I discovered that the ribbon cables for these ports were neatly wrapped with rubber bands inside the case, but there was nothing to which you might attach them! In effect, the computers came without any parallel or serial ports.

MEMORY DESIGN The Laser Digital motherboard has an unusual memory design: it uses two banks of eight 256-kilobit by 4-bit chips, plus another set of eight 256-kilobit by 1-bit parity chips. The 24 chips add up to a total of 2MB of memory, and the motherboard has room for only another 2MB. To add more RAM, you'll have to use a memory board in the single 32-bit slot.

The story behind the American Megatrends system board on the 25-MHz test system is even more interesting. First off, the company says it is no longer selling this motherboard, but will instead be shipping a similar model from Abacus. The AMI motherboard we saw can accept either 256Kb, 1-megabit, or 4Mb DIP chips and 256Kb or 1Mb SIMMs. You can fit a total of 8MB of memory on the motherboard using four banks each of 1Mb DIP and 1Mb SIMM packages. If you need more RAM, a 32-bit expansion slot is available.

What's even more intriguing is that our test 25-MHz system came equipped with only 2MB of RAM, although Laser Digital lists 4MB of RAM as standard in the base configuration.

Both computers came with the AMI BIOS, which offers setup in ROM that can be accessed during boot-up. The Pacer 386 20 and 386 25 test configurations, priced at $3,792 and $5,247, respectively, came with large hard disks and Western Digital ESDI controllers, as well as separate floppy disk drive controllers. They also had 8-bit VGA adapters and Tatung monitors. A manufacturer's name was not visible on the Enhanced-style keyboards, but the feel was mushy and unremarkable.

Even with memory caching, the 25-MHz system did not garner outstanding marks on our benchmark tests. In fact, both machines turned in only respectably average performances.

The documentation for these machines was their weakest feature. The same manual came with both systems and neither the motherboard nor other features described in it applied to the test units. The 25-MHz model did come with a more-accurate supplemental manual, but imagine the confusion of a new user trying to divine which manual to trust.

Laser Digital's prices for fully equipped systems may seem attractive initially, but when you look at their less-than-flexible expansion schemes, poor documentation, and so-so performance figures, you must conclude that neither is as much of a value as it might at first appear.

—Alfred Poor

PC MAGAZINE FACT FILE

Laser Digital Inc.
1024 Morse Ave.
Sunnyvale, CA 94086
(800) 826-4225
(408) 747-1966

Pacer 386 20
List Price: With 2MB RAM, 1.2MB 5¼-inch floppy disk drive, $1,961; with 80MB hard disk, monochrome monitor, DOS 3.3, $3,000; with VGA monitor, $3,972. 1MB RAM upgrade, $360; 60MB tape backup, $590; 150MB hard disk, $1,495.

CIRCLE 614 ON READER SERVICE CARD

Pacer 386 25
List Price: With 4MB RAM, 1.2MB 5¼-inch floppy disk drive, $3,500; with 80MB hard disk, monochrome monitor, DOS 3.3, $4,400; with VGA monitor, $5,149; with 130MB hard disk, $5,495. 1MB RAM upgrade, $360; 60MB tape backup, $590; 150MB hard disk, $1,495.

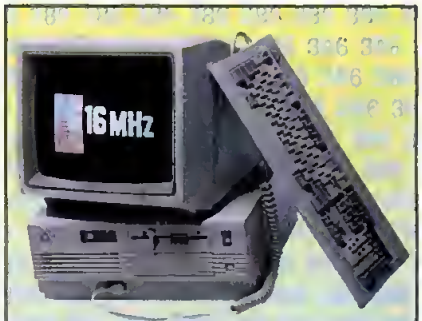
CIRCLE 615 ON READER SERVICE CARD

In Short: A poorly designed case, the absence of standard ports, and documentation that is as thin as it is confusing all gang up to overwhelm the Pacers' low prices. Other machines offer more consistent quality and value for the money than you will find here.

LEADING EDGE HARDWARE PRODUCTS INC.
LEADING EDGE MODEL D3

If you've ever owned a Leading Edge computer before, the Leading Edge Model D3 16-MHz 386 machine will look as familiar to you as your reflection in a mirror. Like its 8088- and 80286-based predecessors, the Model D3 is a small-footprint (16 by 16 by 6½ inch HWD), lightweight (35-pound) box. Even the documentation looks familiar, except this time around you get a Microsoft OS/2 reference manual (although the machine comes standard with DOS 3.3).

The Model D3 does depart from its slower ancestors in more important respects. Inside the identical casing lies a 16-MHz Intel 80386 chip (switchable to 8



Storage space on the Leading Edge Model D3 is too limited for it to be a server, but home users will appreciate the 65MB hard disk, VGA monochrome display, and word processor that are included in the attractive base price.

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EXP.	7 SLOTS
DEVICE SPACES	6
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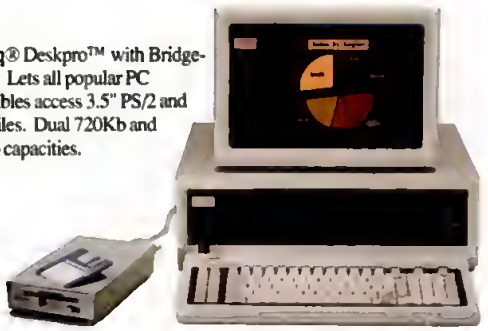

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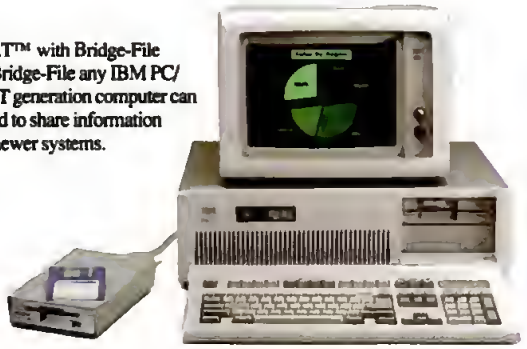

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CIRCLE 173 ON READER SERVICE CARD

MHz), and 1MB of motherboard 100-nanosecond SIMM RAM (expandable to a 32-bit maximum of 8MB), for $3,795.

APPEAL FOR THE HOME CROWD Known among home computer enthusiasts for packing a lot into an attractively priced bundle, the base system includes *Leading Edge Word Processing* and a 65MB Microscience hard disk. The test configuration added a GoldStar VGA monochrome display. One parallel and two serial ports, as well as a high-density floppy disk controller, are on the Daewoo motherboard, leaving the two 8-bit and two of the four 16-bit slots free for expansion. The remaining two 16-bit slots will be used for the Adaptec hard disk controller and ATI VGA adapter.

Problems will arise if you need a machine with lots of room for storage devices. The hard disk drive is installed vertically to the right of the two half-height bays (one of which is occupied by the standard 5¼-inch floppy disk drive), leaving only one free half-height bay.

Obviously, this unit is not server material, and it's too limited to have much appeal for even the unnetworked corporate user. The FCC Class B–rated machine is better suited as a logical upgrade for the Leading Edge devotees and other home users who want more processor speed than their current system gives them.

PC MAGAZINE FACT FILE

Leading Edge Model D3
Leading Edge Hardware Products Inc.
225 Turnpike St.
Canton, MA 02021
(800) 343-6833
(617) 828-8150
List Price: With 1MB RAM, 65MB hard disk, 1.2MB 5¼-inch floppy disk drive, DOS 3.3, $3,795; with VGA monochrome monitor, $3,994; with VGA monitor, $4,483. 1MB RAM upgrade, $996.
In Short: If you can live without support or future enhancement options, there are bound to be some great going-out-of-business deals on the Model D3. No speed demon, this small-footprint machine is best suited for Leading Edge devotees and other home users who want to increase processor speed.
CIRCLE 643 ON READER SERVICE CARD

SPEED AND UPGRADABILITY No one could mistake this machine for a real speed demon. The processor, disk, and memory benchmark tests were unimpressive, although the machine does have exceptional video capabilities. The 16-bit ATI adapter, the VGA monitor, and RAM shadowing of the video BIOS gave it the boost necessary for fast screen output.

To get into the machine, you need only unscrew one screw and flip a clip, but installing an Intel 80387 math coprocessor (Weitek is not supported) is another story.

Home users have known Leading Edge to pack a lot inside its attractively priced bundles.

You'll have to remove the floppy disk drive chassis to access the coprocessor socket on the motherboard. While you're under there, you may also want to upgrade your memory, as the RAM is located close by. To get the maximum 8MB of 32-bit RAM, you'll have to swap 1MB chips for the standard 256K chips.

The most distressing thing about this situation is that Leading Edge, which has always enjoyed a solid reputation, has filed for Chapter 11 bankruptcy protection. This has led Daewoo Telecommunications, the builder and supplier of the machines, to terminate its contract with the company. Unless the situation has changed by the time this issue is shipped, you should make sure that the system is in stock at the dealership before plunking down your money. If you're not uncomfortable without support or future enhancement options, take a good look: you may be in for a great deal.
—Kate Emery

MEMOREX TELEX CORP.
MEMOREX TELEX 386-20

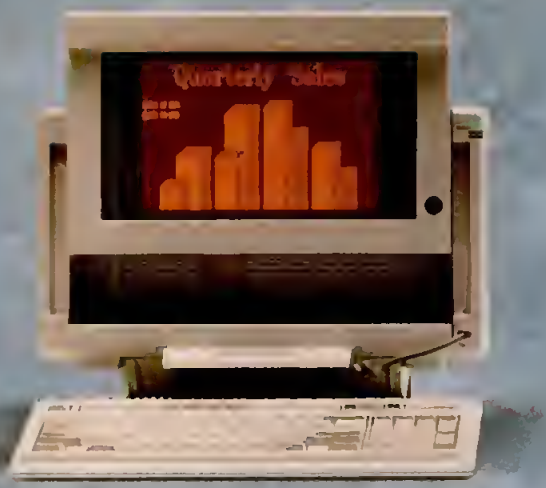
The newest and top-of-the-line entry in Memorex's Intelligent 7000 series, the Memorex Telex 386-20 (base priced at $4,595), is a class act all the way. The small-footprint chassis is handsomely designed with a recessed bottom to minimize desktop space requirements. Its economical use of space includes a vertically oriented 1.44MB 3½-inch floppy disk drive. Although they don't come standard, there's also room for two horizontally mounted 5¼-inch floppy disk drives at the center of the machine.

Other pleasant design features include the NMB Hi-Tek keyboard, which plugs conveniently into the front of the chassis, and horizontally oriented, well-labeled plugs for the printer and RS-232 ports on the rear of the machine. While the horizontal orientation is simply a by-product of the parallel and serial ports (as well as the floppy disk drive controller) being built into the American Mitac motherboard, Memorex's labels make a big difference. Just ask anyone who's ever been stymied by

PC MAGAZINE FACT FILE

Memorex Telex 386-20
Memorex Telex Corp.
4343 S. 118th E. Ave.
Tulsa, OK 74146-4066
(918) 624-1111
(800) 331-2623
List Price: With 2MB RAM, 1.44 MB 3½-inch floppy disk drive, DOS 3.3, $4,595; with 80MB hard disk, monochrome monitor, $7,105; with VGA monitor, $7,699; with 4MB RAM, 1.44 MB 3½-inch and 1.2MB 5¼-inch floppy disk drives, $9,139. 2MB RAM upgrade, $1,195; 40MB internal tape backup, $595; 5¼-inch floppy disk drive, $245.
In Short: This small-footprint machine combines sleek design with solid performance. It comes chock-full of RAM (2MB) standard and has the floppy disk drive controller and ports built into the motherboard. You're encouraged to populate the machine to your liking (the base configuration is sparse) with Memorex's components, but add-ins can get pricey.
CIRCLE 621 ON READER SERVICE CARD

COMPAQ DESKPRO 386s



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COMPAQ DESKPRO 386/20e

COMPAQ DESKPRO 386/25

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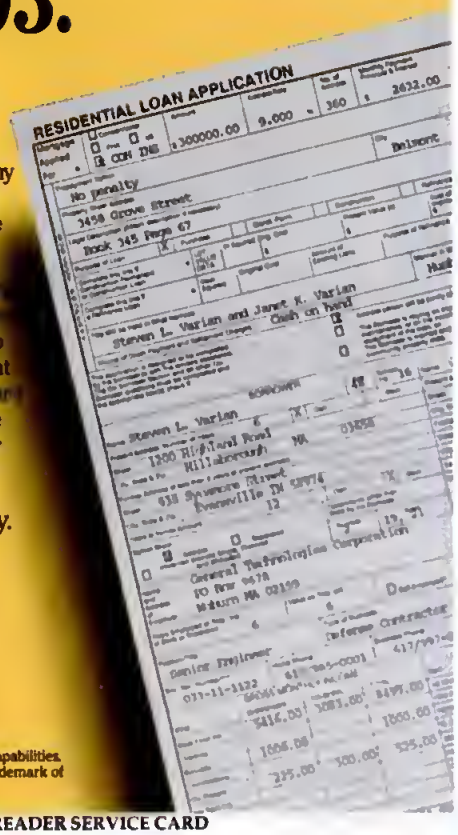

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CIRCLE 525 ON READER SERVICE CARD

■ 80386 DESKTOP PCs

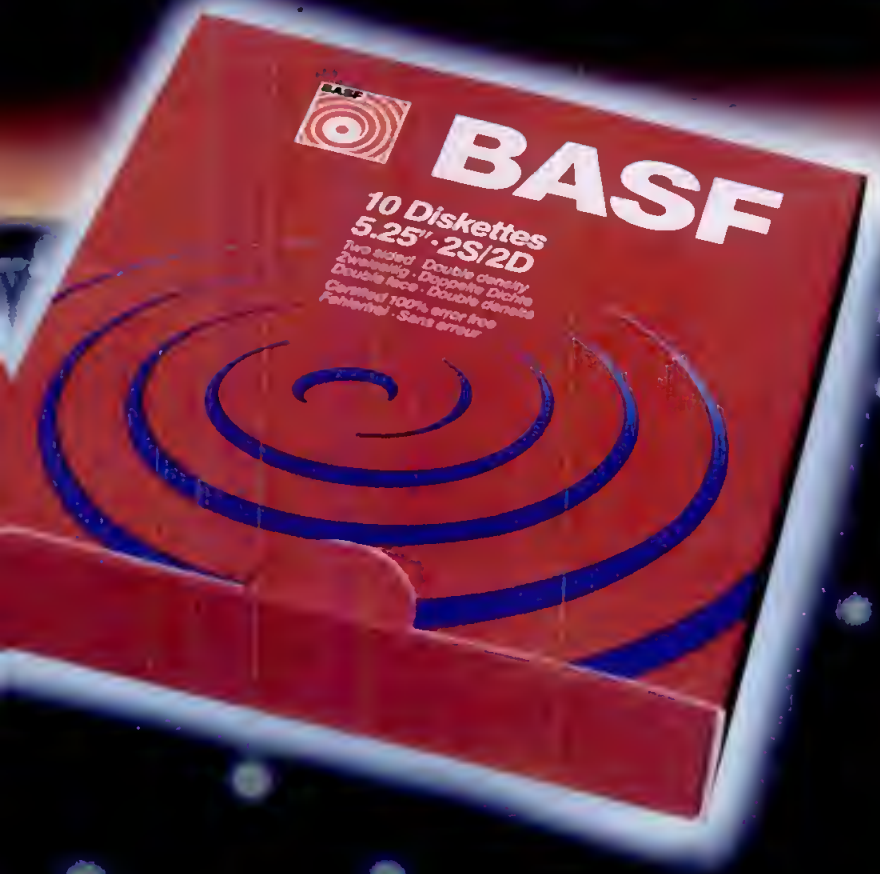
The recessed bottom helps minimize the desktop space that the small-footprint Memorex Telex 386-20 will consume. The vertically oriented floppy drive is another space saver. Other design pluses: labeled ports and an accident-proof power-on button.

the "all the ports look the same" dilemma.

In addition, the ubiquitous and anachronistic red on/off toggle switch is replaced with a nearly accident-proof pushbutton on the front panel—you'll really have to press this button hard to get the machine to reset.

DESIGN ODDITIES Occasional design oddities do crop up. The front panel of the 20-MHz system includes power-on, hard disk activity, and turbo LEDs, but the turbo indicator is dormant because the processor speed is not selectable (although bus speed and wait states are). Another curiosity is the case: it has room for six expansion slots, but the motherboard only has five—four 16-bit and one 8 bit. Memorex fills what would be the sixth expansion slot location with a standard 2MB of SIP memory.

The optional 80MB 3½-inch Quantum hard disk ($2,000) that came with our test system lay comfortably wedged to the side of the power supply. While the RLL controller is cleverly built into the drive itself, a slot must still be dedicated to a Quantum paddleboard interface that allows the motherboard to communicate with the hard disk/controller. (Quantum says the paddleboard interface was released in hopes that motherboard manufacturers



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CIRCLE 391 ON READER SERVICE CARD

would ultimately incorporate the design into the system board.) A more efficient design would be to use a motherboard that allows the hard disk/controller to be plugged right into it, thereby eliminating the need for the paddleboard.

Our benchmark tests proved Memorex to be a consistent if not speedy player. Shadow RAM (both BIOS and video) enhance performance, as does the two-way paged interleaving.

Memorex's prices are not the lowest you'll find; for example, our test configuration, with the standard 2MB RAM, the pricey 80 MB hard disk, a 5¼-inch floppy disk drive, and a VGA card and monitor, came to $7,944. But if you're ready to relinquish your Cadillac-sized desktop model in search of a sleeker, trimmer breed, the Memorex Telex 386-20 should not be overlooked.—**Robin Raskin**

A real bonus of the Micro Express 386-25 is that its reasonable base price includes 4MB of 80-nanosecond DRAM on the motherboard. The motherboard also accommodates 64K of 25-ns. cache memory, which gives the system a real boost.

MICRO EXPRESS INC.

MICRO EXPRESS 386-20
MICRO EXPRESS 386-25

Micro Express is a relatively new company that assembles high-performance computers from brand-name components at realistic prices. In many respects, the Micro Express 386-20 and Micro Express 386-25 rank with the top competition.

One of the best things about these machines is the prices. For $2,100 you get the 386-20 with 1MB RAM, a 5¼-inch 1.2MB floppy disk drive, one parallel port and one serial port, and an Enhanced-style keyboard; DOS can be purchased for an additional $75. The base configuration of the 25-MHz unit includes the above plus three more MB of RAM for $3,995.

The prices of our test configurations were also competitive. The 20-MHz evaluation unit, with 4MB of RAM, Control Data 150MB hard disk, 1.2MB floppy disk drive, VGA card and monitor, and DOS 3.3 came to $4,824. The 25-MHz machine we tested, with a Micropolis 140MB hard disk, DOS, and the same VGA card/monitor combo, totaled a reasonable $7,324.

Both machines are identical on the outside, resembling a standard PC AT–sized box. A reset switch and a key lock sit on the lower left side of the case, where they won't be in the user's way. Looking under the cover, you'll find that most of the components are supplied by the same manufacturers, usually well-known outfits. NEC builds the monitors and Paradise makes the video cards. The motherboard and BIOS software are from American Megatrends, and the chip set maker is Chips and Technologies.

In each test configuration, the motherboard hosted the CPU and 4MB of RAM. While the 20-MHz unit uses slower, 100-nanosecond DRAM, the 386-25 zips along with 80-ns. DRAM. You can expand to 8MB of 32-bit RAM on the motherboard. And if you're preparing to run memory-hungry applications, a 32-bit expansion card can be used to fill the system with 16MB. The motherboard also incorporates a full 64K memory cache, operating with 35-ns. static RAM chips in the 386-20 and 25-ns. DIP RAM chips in the 386-25.

The layout of the two machines is pretty standard. There are eight full expansion slots: one 32-bit proprietary slot, six 16-bit slots, and one 8-bit slot, allowing for a fair, if not dazzling, variety of expansion options.

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PC MAGAZINE FACT FILE

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Micro Express 386-20
List Price: With 1MB RAM, 1.2MB 5¼-inch or 1.44MB 3½-inch floppy disk drive, $2,100; with 72MB hard disk, monochrome monitor, DOS 3.3, $2,950; with VGA monitor, $3,550; with 4MB RAM, 150MB hard disk, $5,350. 1MB RAM upgrade, $400; 60MB tape backup, $675.

CIRCLE 619 ON READER SERVICE CARD

Micro Express 386-25
List Price: With 4MB RAM, 1.2MB 5¼-inch floppy disk drive, $3,995; with 72MB hard disk, monochrome monitor, DOS 3.3, $4,845; with VGA monitor, $5,445; with 4MB RAM, 150MB hard disk, $6,345. 1MB RAM upgrade, $400; 60MB tape backup, $675.

CIRCLE 620 ON READER SERVICE CARD

In Short: One of the best things about this relatively new company's machines is their prices. But there's more: brand-name parts, 64K disk cache, and good benchmark test scores. Worth a look.

dard. Three of the bays on the right have openings in the case front; the other two cannot be easily accessed.

ME 386-20 The ME 386-20 scored impressively in the benchmark tests. It was consistently among the fastest in the 80386 Instruction Mix, Conventional Memory, and Extended Memory tests. This is due to the use of the 64K cache with 35-ns. static RAM chips, as opposed to the popular Intel controller and 32K cache used by many other manufacturers. While increasing the amount of static RAM will speed up your performance only slightly, those few seconds can make a difference.

The 386-20 also scored high on the BIOS Disk Seek test and the large-record DOS File Access test. This can be attributed to the very fast ESDI hard disk. Since it is a high-capacity drive, it has an easier time searching for large files. On the downside, because the hard disk drive is formatted to handle larger files more quickly, it may have trouble dealing with smaller files. This may account for the average score the machine garnered on the small-record DOS File Access test.

ME 386-25 The results of the benchmark tests varied for the ME 386-25. In the 80386 Instruction Mix and large-record DOS File Access tests, the ME 386-25 rated among the top machines. Put this down to the 64K cache and the speed of the hard disk.

But in the PC Labs Extended Memory tests, the ME 386-25 placed in the middle of the pack. Moreover, the ME 386-25 didn't rank very competively in the small-record DOS File Access and BIOS Disk Seek tests when compared with the other machines in its class.

Micro Express computers are a worthwhile choice for high performance on a restricted budget.

While the Micro Express machines performed exceptionally well in many cases, and almost never disappointed, their documentation could use work. It seems like just a bunch of pamphlets on each separate component thrown together, rather than a cohesive manual. The information you want can probably be found, but you'd better be prepared to do some digging.

The Micro Express computers are a good choice for users who want high performance but are on a restricted budget. The unusual 4MB of RAM standard on the 25-MHz unit is a real bonus. As long as you don't have to depend on their documentation, the Micro Express 386-20 and 386-25 deserve a close look.

—Lonnie Lum and Elisa J. Hirsch

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John C. Dvorak
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CIRCLE 216 ON READER SERVICE CARD

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MICRO 1 INC.
MICRO 1 POWER 386-16
MICRO 1 POWER 386-20

When it comes to computers, you have to choose between price and performance, right? You have to pick a basic model that is stripped of features or pay big bucks for the bells and whistles that make a machine go fast.

Meet the Micro 1 Power 386-16 and Micro 1 Power 386-20, the two computers that are fast turning this belief into a misconception. The low base price of $1,530 for the 16-MHz version and $2,010 for the 20-MHz model includes 1MB of RAM, one 1.2MB 5¼-inch floppy disk drive, a keyboard, and the AMI BIOS. Better yet, the fully loaded Power 386-16 and Power 386-20 test configurations racked up price totals of only $3,385 and $3,865, respectively.

The test prices include 2MB of RAM in the 16-MHz version and 4MB in the 20-MHz model, as well as an 80387 math coprocessor, a parallel port, a game port, and two serial ports in both. The 16-MHz model had two 25-pin serial connectors, while the 20-MHz version sported a 25-pin and 9-pin pair for its ports. Both also included hard disk options, VGA equipment, and Key Tronic 101-key XT/AT keyboards, which have an adequate but unimpressive feel.

Despite their low prices, the Micro 1 machines don't give up any points in the performance arena. The Power 386-16 and Power 386-20 use different versions of the American Megatrends Inc. (AMI) motherboards, but both models come complete with hardware memory cache. This no doubt helped the systems turn in impressive results on the memory benchmark tests. On these, as well as on the CPU tests, each machine logged in times that often placed it near the top of its class.

POWER 386-16 The 16-MHz unit is packaged in a typical desktop AT-clone case, with three of its five half-height drive bays open from the front. The motherboard offers the usual complement of eight slots, including one 8-bit, six 16-bit, and one proprietary 32-bit.

The 32-bit slot is already filled with a memory expansion card when you buy the machine, as the motherboard does not hold any RAM itself. The memory card will take 8MB directly and another 8MB via a daughtercard. The 16MB 32-bit RAM total should be more than adequate for today's OS/2 and DOS applications.

The Power 386-16 also came with a half-height 45MB Toshiba hard disk, driven by an Omti combination floppy/hard disk controller. A Relisys VGA color screen and 16-bit Paradise VGA rounded out the system.

POWER 386-20 The Power 386-20 came in a vertical clone case. The unit has room to accept up to six half-height devices, all of which can be accessed through holes in the front panel. Unlike its sibling's desktop case, which relies on side rails for mounting drives, the 386-20 lets you bolt the devices directly to the drive bay, just as you could with the original IBM PC and XT chassis.

The 386-20 version of the AMI motherboard also sports one 8-bit, one 32-bit, and six 16-bit slots. Unlike the motherboard found on the 16-MHz system, this version accepts RAM, and it does so in both DIP chips and SIMM memory packs. Eight megabytes can be piled onto this board (using 1-megabit chips and modules) before you need to consider filling the 32-bit slot with a memory card that can hold another 16MB of RAM. The total 32-bit memory capacity of 24MB is perfect for Unix installations. On the other hand, if the 8MB of motherboard RAM is enough for now, the 32-bit slot will happily serve as a home for an 8-bit card.

PC MAGAZINE FACT FILE

Micro 1 Inc.
557 Howard St.
San Francisco, CA 94105
(800) 338-4061
(415) 974-5439

EDITOR'S CHOICE

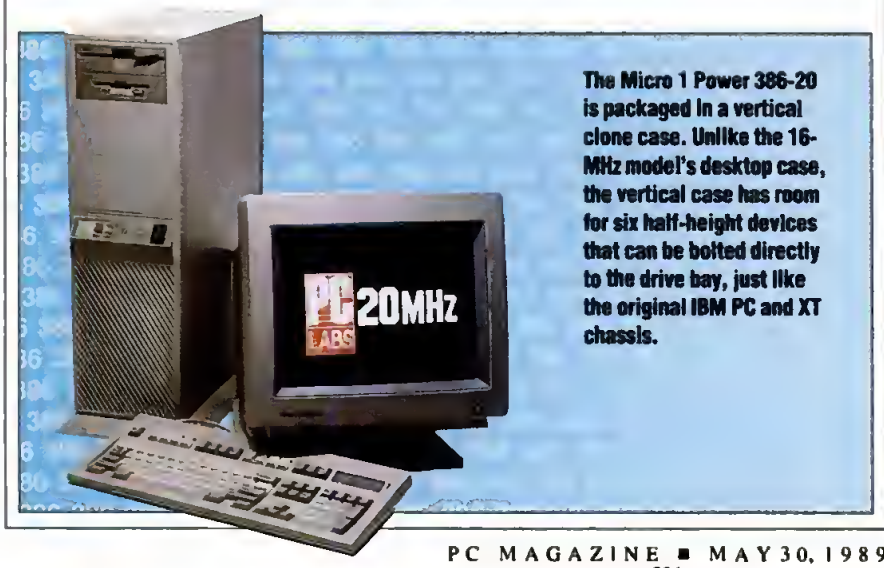
Micro 1 Power 386-16
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, $1,530; with 60MB hard disk, monochrome monitor, DOS 3.3, $2,095; with VGA monitor, $2,550; with 2MB RAM, 45MB hard disk, 80387 coprocessor, $3,385. 1MB RAM upgrade, $350; 60MB tape backup, $295.

CIRCLE 633 ON READER SERVICE CARD

Micro 1 Power 386-20
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, $2,010; with 60MB hard disk, monochrome monitor, DOS 3.3, $2,575; with VGA monitor, $3,030; with 4MB RAM, 140MB hard disk, 1.2MB 5¼-inch and 1.44MB 3½-inch floppy disk drives, 80387 coprocessor, $3,865. 1MB RAM upgrade, $350; 60MB tape backup, $295.

CIRCLE 634 ON READER SERVICE CARD

In Short: The Micro 1 Power 386 computers are big on performance and low on price. Their documentation is their biggest liability, but they use good-quality components that get the job done. These models may well represent some of the best values in their class.



The Micro 1 Power 386-20 is packaged in a vertical clone case. Unlike the 16-MHz model's desktop case, the vertical case has room for six half-height devices that can be bolted directly to the drive bay, just like the original IBM PC and XT chassis.

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- 1x32 BIT, 4x16 BIT, 3x8 BIT SLOTS
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- XENIX & NOVELL COMPATIBLE
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- (2) PARALLEL PORTS
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FEATURES:

- INTEL 80386 16/20 CPU
- EXPANDABLE TO 8 MB DIRECTLY ON BOARD
- UP TO 16-MB TOTAL RAM
- 0 WAIT STATE (PAGE INTERLEAVED MEMORY ACCESS)
- 80387 MATH CO-PROCESSOR SOCKET
- NORTON SI = 23
- LANDMARK = 26 MHz
- THRDUGHPUT = 500 KB
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The 20-MHz model came with a 140MB full-height Toshiba hard disk attached to an Adaptec floppy/hard disk controller. The 16-bit Paradise VGA was hooked up to a 16-inch Nanao multifrequency FlexScan color monitor; the big picture screen was a dramatic and refreshing change from the smaller monitors that came with the other computers I reviewed.

The fit and finish on both these machines was acceptable, but the documentation proved to be a weak link. The instructions were of the fairly typical brown-bag variety: simply a collection of pamphlets and manuals from the component manufacturers enclosed in a three-ring binder.

Novices unfamiliar with MS-DOS computers and their components may want to spend the extra money for a machine that more explicitly outlines its capabilities and operation. But if you are comfortable and confident in getting around a PC, the low prices and superior performance of the Micro 1 machines make them a bargain that you have to consider.—**Alfred Poor**

MITSUBISHI ELECTRONICS AMERICA INC.

MITSUBISHI MP386

If Mitsubishi's 386 computer could zoom at 20 or 25 MHz instead of merely zipping along at 16 MHz, it would be one of the unquestioned champions of this survey. But even at 16 MHz, the MP386 stands out, thanks to its broad shoulders and remarkable adaptability.

The 23-inch-wide shoulders of this desktop machine, which is base-priced at $3,995, suggest its special capabilities. The motherboard has 11 expansion slots, including 1 proprietary slot that holds a 32-bit card with 1MB of RAM standard (and room for 1MB more) and part of the hardware cache. Two serial ports, a parallel port, and a floppy disk drive controller reside right on the motherboard, so that even when you install a hard disk drive controller and a video card, you still have eight full-length slots remaining. And even after plugging in a network card, a scanner controller, a fax board, an image-capture board, a secondary video adapter, and

Considering its 23-inch-wide shoulders, it's not surprising that the desktop Mitsubishi MP386 holds 11 expansion slots. What's even more appealing to network users is that most of these slots are available, since the two serial ports, a parallel port, and a floppy controller reside on the motherboard.

8MB more of RAM between two 32-bit memory boards, you'd still have a slot left over.

The MP386 has five drive bays; three are accessible from the front, so you can fit in the 1.2- and 1.44MB floppy disk drives and a tape backup unit and still have room for a full-height hard disk.

Mitsubishi can supply its own monochrome, EGA, or VGA monitors and cards, as well as 40- and 70MB hard disks designed to be used with a standard ST-506 controller. Our test machine had a Mitsubishi EGA card and monitor and a moderately well-performing but virtually silent 40MB CDC hard disk. MS-DOS 3.3 comes with the machine; Xenix System V is a $595 option. Mitsubishi also includes Multisoft Corp.'s *Super PC-Kwik* disk cache, the editor's choice in PC Magazine's recent survey of cache software (see "Getting the Most Out of Memory," February 14, 1989, page 157).

THE NETWORK CONNECTION The expansion capabilities of the MP386 make it an ideal network server. Mitsubishi evidently had this possibility in mind because it offers an optional intelligent multiport (with eight ports) for $995 and a four-channel RS-232C controller at the rather odd price of $202. For number-crunching, Mitsubishi can sell you an 8-MHz 80287 coprocessor, but you're better off installing a 16-MHz 80387, obtainable from other suppliers.

As a network server, the MP386 includes some well-thought-out safety features. The rocker-style power switch is recessed enough to be hard to hit accidentally. Similarly, the reset switch on the front panel is hidden by a door and can be reached only with a pen or a similar tool. The same door hides DIP switches that let you configure I/O ports, video, and memory mapping without taking the top off the case.

The MP386 performed among the better 16-MHz machines, although its extended-memory timings were notably slow. The computer comes with a standard 32K hardware cache that can be doubled in size. When doubled, the cache becomes a dual-associative design for even greater speed.

Mitsubishi's manual is exceptionally clear and detailed, and the internal components of the computer display outstanding workmanship and quality. I hope Mitsubishi may someday decide to manufacture its own keyboard instead of supplying a Key Tronics Enhanced-style model. It is less mushy than most clone keyboards but still too soft for comfort.

PC MAGAZINE FACT FILE

Mitsubishi MP386
Mitsubishi Electronics America Inc.
991 Knox St.
Torrance, CA 90502
(800) 556-1234
(800) 441-2345
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, DOS 3.3, $3,995; with 70MB hard disk, monochrome monitor, $5,895; with VGA monitor, $6,795; with 2MB RAM, 40MB hard disk, EGA monitor, $6,155. 1MB RAM upgrade, $260.
In Short: Mitsubishi's base system is a solidly built desktop machine with ten expansion slots, ideally suited for use as a network server. A full range of network and other options, plus excellent documentation, combine to make this an attractive choice for corporate and scientific use.

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Anyone in the market for a 386 with almost limitless expansion, high-quality components, and excellent documentation should take a long look at the Mitsubishi MP386. There are faster machines out there, but few that are better built.
—Edward Mendelson

NCR CORP.
NCR PC916

Not all clones come from the Far East; the NCR PC916 is a case in point. While NCR headquarters is in Dayton, Ohio, the machine is assembled in West Germany. For a big-league base price of $4,495, the European assembly line will configure your system with a 16-MHz CPU, one floppy disk drive, and 2MB of RAM (but no keyboard or display). That price also buys you a machine that, from its distinctive case to its passive backplane design, is clearly the product of independent thinking.

A passive backplane on the NCR PC916 hosts one card with the CPU, another with memory. Since there are no 32-bit slots, these two cards establish a 32-bit data path through a pair of edge-connector sockets. A third card houses the floppy/hard disk controller, ports, and a video card.

The case offers the standard five half-height drive bays, but only two appear to be accessible through the front panel. A gentle tug at the front bottom edge will drop down a hinged cover, allowing you access to a third half-height device. This cover also hides a power switch, a key lock, and a volume control for the speaker. An attractive smoke-colored plastic dust-cover slides over the other two disk bays. The case is designed to work in either a desktop or upright arrangement.

Inside, you will find other clever little details. Glued to the top of the disk bay housing is a plastic tray that contains all the screws and rails you need to mount additional drives. The PC916 even comes with a screwdriver.

OFF THE BEATEN TRACK The component design is very atypical. The PC916 uses a passive backplane design that offers two 8-bit and six 16-bit slots. The CPU re-

THE 80386SX GETS A JUMP START

Nearly a year after its debut, this child star of microprocessors is pushing aside the 286 and coming into its own.

Even before it was announced on June 20 of last year, Intel Corp.'s 16-MHz 80386SX microprocessor was causing a stir in the industry. And when Compaq Computer Corp. introduced its small-footprint 386S engineered around the 80386SX last July, we heralded Compaq's continued innovation and leadership in the 386 market. (See "Compaq's Deskpro 386S: Less Is More," *PC Magazine*, August 1988.)

But there still seems to be a lot of confusion about what the 80386SX is and what it isn't, and why you should buy a 386SX-based machine as opposed to a fast 286-based machine or a full-fledged 386. Here's some help.

MEMORY ARCHITECTURE What makes the 80386SX microprocessor so interesting? The 386SX is a hybrid of the 386 and 286: it uses 32-bit internal processing, as does the 386, but operates with a 16-bit external data bus, like the 286. In processing power and instruction set, the 386SX is the equivalent of the 386. And like the 386, it offers a 4-gigabyte address space.

Another trait the 386SX has in common with the 386 is its support of virtual 86 mode; this allows hardware support for simulating multiple 8086-type CPUs within one PC. The result: you can take advantage of multitasking software like *DESQview 386*, *Microsoft Windows/386*, and *VM/386*, which let you run your applications concurrently.

What, however, is the advantage of decreasing 386 power by operating with a 16- rather than a 32-bit external data bus? A 16-bit data and memory path allows the 386SX chip to operate in an AT-class machine—compatible with all AT-class peripherals and expansion cards. The total cost of producing such a machine is similar to that of a fast 286, as opposed to the faster but ordinarily pricier 386.

Unfortunately, there's no easy upgrade: it's tougher than just purchasing a 386SX chip and plugging it into your AT's 286 microprocessor socket. Different in size and construction from any type of 286 chip, the 386SX is manufactured using a new type of packaging designed strictly for surface mounting—the 100-pin Plastic Quad Flatpack.

Several manufacturers, Cumulus Corp. ((216) 464-2211) and Aox ((617) 890-4402) among them, plan to release 386SX adapter cards that will plug into a 286 socket. Since the 80286 can be packaged in several ways, be sure the type of board you choose will plug into the 286 socket on your AT's motherboard.

THE MIDRANGE Intel claims that the demand for the 386SX chip has been the greatest of any processor within the

sides on one card and the memory on a companion card. These two cards establish a 32-bit data path through a pair of edge connector sockets that stick to the bottom of the chassis via two stand-off posts with double-faced tape on their bases. (The tape covering was still in place on the evaluation model, making it impossible for the posts to stay put. NCR said this was an accident and not standard on all the machines it ships.)

A third card, called the Personality Board, serves as the floppy/hard disk controller. It also carries a daughtercard video adapter that uses Paradise VGA chips. The same card holds the parallel and serial ports.

There is an inherent problem with this design. The NCR format means that you will have to rely on the company to fulfill your CPU and memory expansion needs. And while you could replace the standard Personality Board with separate cards, you'll have to give up precious slot space.

PC MAGAZINE FACT FILE

NCR PC916
NCR Corp.
1601 S. Main St.
Dayton, OH 45479
(800) 544-3333
(513) 445-5000
List Price: With 2MB RAM, 1.2MB 5¼-inch floppy disk drive, $4,495; with 70MB hard disk, monochrome monitor, DOS 3.3, $6,690; with VGA monochrome monitor, $6,949; with VGA color monitor, $7,194. 2MB RAM upgrade, $1,550; 60MB tape backup, $1,995.
In Short: The NCR PC916 offers an unusual design with better-than-average performance for a 16-MHz machine. Unfortunately, flawed documentation and bungled details, in addition to its relatively high price, make it a less-appealing value than other 386 machines in its class. Unreliability may also be a problem.

CIRCLE 626 ON READER SERVICE CARD

The PC916 does have some other problems. The speed-changing program does not work as described. You get a diagnostic disk, but you are required to copy it before it will run. You can't simply copy it to your hard disk, either; you must do the floppy shuffle on the one drive that comes standard.

The disk-based help system is a good idea, but the programmed colors are such that you cannot read any of the screens on the monochrome display that NCR supplied with the $6,949 evaluation unit. There is no documentation that explains how to change the colors.

Worst of all, we encountered reliability problems. The first system we were sent simply would not work, while the second unit was cursed with hard disk troubles. The problem was solved when NCR sent us a replacement hard disk.

The machine turned in better-than-average CPU and memory times on the PC Labs benchmark tests. The replacement

PC MAGAZINE Comparative Pricing: A 386 Family Portrait

As prices of 80386SX-based computers dip closer to those of their 80286-based brethren, the number of reasons for stopping short inevitably grow fewer. This table shows back-to-back the prices of comparable machine configurations offered by companies now shipping 386SX-based machines. Because the basic configurations vary from one company to another, it is not possible to directly compare 386SX prices. (Note: Advanced Logic Research prices include VGA graphics and the 82385 cache controller; NCR Corp.'s include VGA graphics and a 44MB hard disk; Zeos International's include Hercules graphics, a monochrome monitor, and a 32MB hard disk drive.)

	80286 (12 MHz)	80286 (16/20 MHz)	80386SX (16 MHz)	80386 (16/20 MHz)
ALR	$1,995 (12.5 MHz)	N/A	$2,695	$3,799 (20)
Club AT	$1,495	N/A	$1,595	$1,995 (16)
Compaq Computer Corp.	$2,699	N/A	$3,599	$5,199 (20)
Computer Products United	$995	$1,195 (20)	$1,295	$1,995 (20)
Everex Systems	N/A	$2,599/$3,099	$2,899	$3,699 (16)
Mitsuba Corp.	N/A	$2,065 (20)	$2,145	$2,455 (20)
NEC Information Systems	$2,395	N/A	$3,395	$4,895 (20)
NCR Corp.	N/A	N/A	$5,195	$5,645 (16)
Zeos International	$1,972	$2,193 (20)	$1,695	$2,495 (16)

N/A–Not applicable. Company does not make a model rated at this speed.

first 6 months of its launch period—five times more 386SX chips were shipped than 386 chips, ten times more than 286 chips. In fact, Intel now devotes two facilities to production of the 386SX chip and claims to supply over 100 computer manufacturers with the chips.

Intel's strategy in introducing the 80386SX seems to be to retain its leadership role in the microprocessor market. Machines engineered around fast 80286 chips from competitors Harris Corp. and AMD have been gaining a firm foothold in the middle tier of computing power. So by offering more than the speed of these fast 80286 chips, the 80386SX is Intel's attempt to reclaim the midrange market that has begun to creep away.

By adding an entry-level 386 processor to the Intel 386 family, the chip supplier is able to offer complete mid-level and high-end microprocessor solutions within the 80386 product line. This solution would downgrade the 286 to the lower tier of processing power, the niche currently occupied by the 8088.

PRICE WARS Despite this strategy, until the close of 1988 few 386SX-based machines had appeared in the marketplace, and sales of those had proved slower than anticipated. The market for 386SX-based machines, in other words, was languishing rather than booming. Some industry analysts were already viewing these machines as white elephants—doomed to be a short chapter in PC history, as was another hybrid machine, the IBM XT-286.

But in February, Intel announced it

(continues)

CDC 70MB hard disk showed fairly typical performance for this class of machine.

Even if the PC916 had exhibited thoroughbred performance, it would still be a questionable choice. Its 16-MHz speed is relatively tame in the current marketplace, while its price places it among the top players in the industry. Unless your company demands that you do one-stop shopping with NCR, look elsewhere.—**Alfred Poor**

The NEC PowerMate 386/20 is a practically homegrown machine. Not only does the system sport a proprietary motherboard, but the evaluation unit includes NEC's 155MB hard drive, its responsive 101-key Enhanced keyboard, and the field-leading MultiSync II monitor.

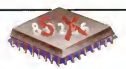
NEC INFORMATION SYSTEMS INC.

NEC POWERMATE 386/20

NEC often waits for markets to mature or open wide before it enters the fray; when it does elbow its way in, it is usually with a substantial product. Such is the case with the PowerMate 386/20, the desktop 386-based model in NEC Information Systems' newly released line of 386-based computers. That line also includes an 80386SX desktop machine (see the sidebar "The 80386SX Gets a Jump Start"), a lunchbox-size 386SX-based unit, and the BusinessMate 20-MHz 386 tower configuration, intended primarily as a Unix multiuser, multitasking system.

The PowerMate 386/20 is a straight 20-MHz machine; for a base price of $4,695, you get 2MB of 32-bit RAM on a memory board, either a 1.2MB or 1.44MB floppy disk drive, and one parallel and two serial ports. The keyboard is NEC's own 101-key Enhanced-style, with a very nice response. In fact, NEC also makes its own motherboard and uses many of its own chips, although the ROM BIOS is from Phoenix.

For $7,395, you can get an alternative base system that differs only in that it uses a memory board with 8MB of 32-bit RAM. The amount of base memory on this machine makes it more suitable for OS/2



"The 80386SX Gets a Jump Start" (continued)

would soon drop the price of the 16-MHz 80386SX chip to $89 (in quantities of 1,000) in its second quarter—from an original price of $165—to enable the 386SX to compete more effectively with fast 286s. In the same quantities, Intel's 12½-MHz 80286 costs $40; Harris sells its 16-MHz 80286 chip for $75 and its 20-MHz 80286 for $100. (Although Intel also plans to cut 80386 microprocessor prices, the price of the 80386SX should remain closer to that of an 80286.)

In the weeks since Intel announced its intentions, several manufacturers of 386SX-based computers, including Compaq, have dropped the prices of their 386SX-based machines, which are now more in line with 286 prices. Overall, the trend is to price 386SX-based machines within a few hundred dollars of high-end 286-based models rather than closer to high-end 386-based offerings. And in the case of Zeos International, a 386SX-based machine is priced *lower* than a 12-MHz 286.

WHY BUY? So why should you choose a 386SX machine over a 286?

■ **Faster performance.** In clock speed alone, the 80386SX is faster than a 12-MHz 80286. Although we haven't put every new 386SX-based machine through the complete battery of PC Labs benchmark tests, initial results for the five 386SX-based machines we tested, from Everex Systems, Zeos International, NCR Corp., Compaq, and NEC Information Systems, compare favorably with those of 16-MHz 386 machines reviewed. Our tests of the Everex and Zeos models also compare favorably with the 20-MHz 286 machines reviewed in "The 80286: Unsafe at Higher Speeds?" (*PC Magazine*, December 27, 1988).

■ **Unix and Xenix.** Although you can run Unix or Xenix on a 286, you'll notice a drastic improvement in performance with a 386SX.

■ **Multitasking.** You don't have to wait for your favorite applications to be rewritten for OS/2 to enjoy the benefits of multitasking. *Microsoft Windows/386*, *DESQview 386*, and *VM/386* are among several multitasking environments you can run with a 386SX-based machine. You can't use them with a 286.

■ **386 applications and compilers.** Several popular applications have been rewritten to use 32-bit instructions, including *Paradox 386* and *Q&A/386*. Thirty-two-bit versions of FORTRAN, C, and COBOL compilers make a programmer's life easier as well.

■ **Price.** With list prices for some 386SX-based machines lower than the prices of 12-MHz 286 machines, and with 386SX chips growing even more plentiful, why lock yourself out of 386 processing power and features?

If you look at the 386SX chip as an enhanced 80286 rather than a crippled 80386, the 386SX market is still an emerging one that's poised to take over the midrange of computing power. As of this writing, at least ten machines had appeared in the marketplace over the past few months, with at least five more ready to ship within a month.

While there are good reasons to buy a 386SX computer instead of a 286, a lower price tag is the only reason to pick a 386SX over a 386. As the prices of 386 machines fall, 386SX prices will have to follow.—**Catherine D. Miller**

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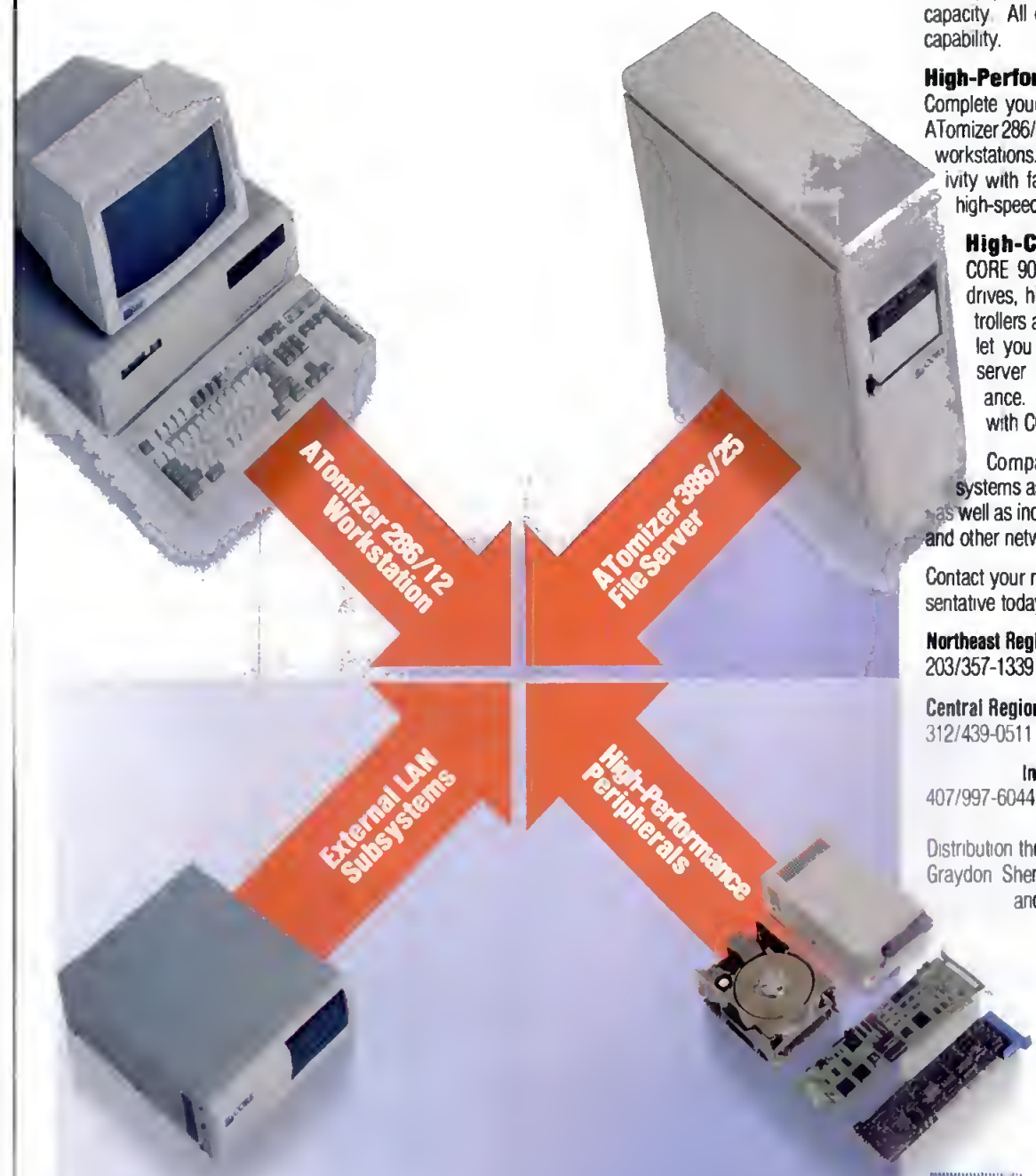

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■ 80386 DESKTOP PCs

and Unix applications than the $4,695 model would be. While DOS comes standard with both NEC PowerMate configurations, you can get OS/2 1.0 for $325 or SCO Xenix for $695.

System memory is composed of 80-nanosecond DRAM chips running with zero wait states and four-way memory interleaving. Automatic RAM shadowing of both video and ROM BIOS is available, but cache memory is not. Accordingly, the PowerMate 386/20 did not do as well in our benchmark tests as the systems with cache RAM did, although it proved itself to be a solid midlevel performer.

MORE MEMORY FOR THE MONEY In the $7,395 unit, system RAM can be expanded to 16MB of 32-bit chips by adding a competitively priced ($4,000) 8MB board that plugs into the standard memory card. Those with conservative memory needs who opt for the 2MB configured system can buy an $1,100 add-on board with room for an additional 2MB of RAM.

The PowerMate 386/20 has ample room for expansion. It can handle up to five storage devices and has a 237-watt power supply with five separate connectors. Besides the single 32-bit expansion slot used for the memory card, you get two 8-bit and five 16-bit slots. Slot space is conserved by building the parallel and serial ports and floppy disk drive controller right into the motherboard. Filling up the empty slots shouldn't cause problems: the expansion bus runs at a rock-solid 8-MHz, ensuring compatibility with older interface cards.

For solid machines from a company with plenty of resources, you can't do much better than NEC.

The Western Digital ESDI hard disk controller on the test configuration managed a NEC 155MB hard disk, with access times under 18 milliseconds. The test configuration also came with the 8MB memory board, a fairly expensive 80387-20 math coprocessor, and an excellent combination of the 16-bit NEC VGA card and the field-leading NEC MultiSync II monitor, all for a hefty $12,735 list price. No need to lose heart, though—NEC's computers are sold only through dealers and are often discounted heavily off the list price.

NEC support and service is also available exclusively through its dealer network and authorized NEC Service Centers, which are located throughout the country. The service centers are an especially fine option to have when your dealer is unable to help you.

NEC is a huge company with lots of resources to back up its products. While the PowerMate 386/20 isn't the fastest, least expensive, or most technologically innovative 386 that we reviewed, it is a solid machine with the right ingredients and enough options to make it effective as a power-user workstation or a small network file server. You could do a whole lot worse than going with NEC, but you can't do much better.—**Bruce Brown**

PC MAGAZINE FACT FILE

NEC PowerMate 386/20
NEC Information Systems Inc.
1414 Massachusetts Ave.
Boxborough, MA 01719
(508) 264-8000
List Price: With 2MB RAM, 1.2MB 5¼-inch or 1.44MB 3½-inch floppy disk drive, $4,695; with 42MB hard disk, VGA monitor, DOS 3.3, $7,240; with 8MB RAM, 155MB hard disk, 80387-20 coprocessor, 16-bit NEC VGA card and MultiSync II monitor, $12,735. 2MB RAM upgrade, $1,100. 40MB tape backup, $695.
In Short: The PowerMate 386/20 is a solid 20-MHz machine for a power-user workstation or a small network file server. NEC is a reputable brand name with an established service and dealer system.

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PC MAGAZINE EDITOR'S CHOICE
February 28, 1989

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Performance Comparisons using PC Labs Benchmark Series Release 4:

	NOP	80386 Instruction Mix	Floating Point Calculation	Conventional Memory
ZEOS 386/20 Desktop	1.66	2.87	10.82	0.38
ZEOS 386/16 Desktop	2.10	3.58	13.62	0.58
IBM PS/2 Model 70-E61	2.09	4.11	16.14	0.77
Compaq Deskpro 386/16	2.09	4.12	158.47	0.75

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Performance Comparisons using PC Labs Benchmark Series Release 4:

	NOP	80386 Instruction Mix	Floating Point Calculation	Conventional Memory
ZEOS 386/33 Vertical	1.01	1.70	6.32	0.25
ZEOS 386/25 Vertical	1.34	2.20	8.35	0.30
IBM PS/2 Model 70-A21	1.34	2.28	8.35	0.28
Compaq Deskpro 386/25	1.35	2.38	8.55	0.39

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NORTHGATE COMPUTER SYSTEMS

NORTHGATE ELEGANCE 386/20
NORTHGATE ELEGANCE 386/25

Northgate Computer Systems' Elegance 386/25 tower model and the desktop Elegance 386/20 represent two real values in the 386 market. The base prices of $3,399 for the 20-MHz system and $3,999 for the 25-MHz unit are reasonable, considering that they include the AMI BIOS, DOS, 1MB RAM, two floppy disk drives, one parallel and two serial ports, a hard disk, and a monographics monitor and Hercules card. In addition, the two systems offer top-flight performance.

Both machines arrived with preformatted hard disks containing DOS and a utilities subdirectory. Among the utilities is a hypertext-like program that gives you online help about DOS, the included utilities, and the system itself. Call up the program, and a quick jab at the arrow keys for topic selection gives you a concise rundown on the hows and whys of what you'd like to do (even experienced users can forget the cryptic options needed to format a 720K disk in a 1.44MB drive). The *Super PC-Kwik* disk-manager software and caching software, as well as the *VOpt* disk optimizer, are also preconfigured and are installed on the system.

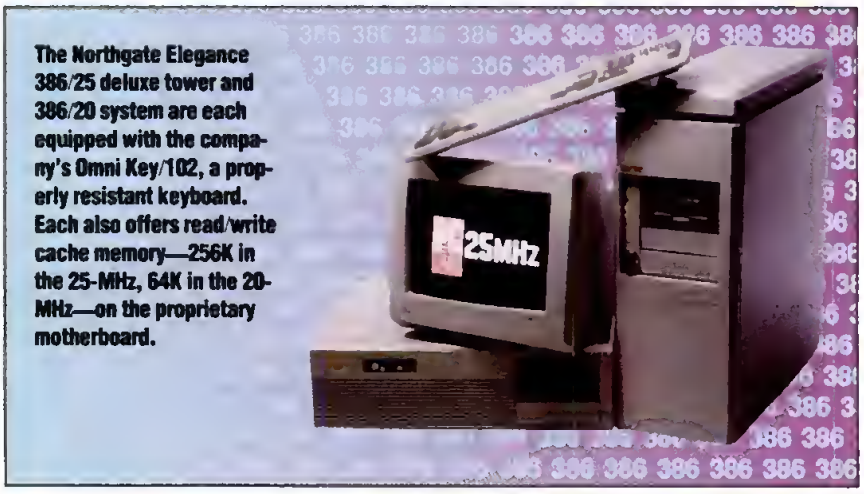
Each machine is also equipped with Northgate's Omni Key 102 keyboard with audible mechanical feedback. It's a gem of no uncertain value, being somewhat less harsh than an IBM keyboard but more resistant than the Jell-o-like keyboards that arrived with many of the other machines reviewed in this issue.

ELEGANCE 386/25 The flagship of the Northgate line is the Elegance 386/25. Our evaluation unit included a deluxe tower, a $975 option (with ten half-height drive bays, a 250-watt power supply with dual variable-speed fans controlled by a thermistor inside the case, and a level to ensure that the 386/25 sits foursquare on the floor) that has finally put to rest my fears that towers are too easy to tip over.

We tested the durability (accidentally, of course) by dropping the 386/25 off a table. An electrical power strip was squashed, the tower was dented, but the computer itself needed only a pass with CHKDSK (it was powered but not running when it fell) to jump back to life.

One important aspect is the read/write-back cache system included with the proprietary motherboard. This is supplied in place of the somewhat exotic page-mode memory addressing found on many 386s, and Northgate claims a hit rate greater than 85 percent for its system. Keep in mind that the best results occur with the largest cache and that the test unit was topped off at 256K.

The $11,394 test system also came equipped with 4MB of RAM (a maximum 16MB of 32-bit memory can be split between the system and memory board) and a gigantic 600MB SCSI hard disk.



The Northgate Elegance 386/25 deluxe tower and 386/20 system are each equipped with the company's Omni Key/102, a properly resistant keyboard. Each also offers read/write cache memory—256K in the 25-MHz, 64K in the 20-MHz—on the proprietary motherboard.

PC MAGAZINE FACT FILE

Northgate Computer Systems
13895 Industrial Park Blvd., #110
Plymouth, MN 55441
(612) 553-0111
(612) 553-0631

EDITOR'S CHOICE

Northgate Elegance 386/20
List Price: With 1MB RAM, 68MB hard disk, 1.2MB 5¼-inch and 1.44MB 3½-inch floppy disk drives, monochrome monitor, DOS 3.3, $3,399; with VGA monitor, $4,024; with 140MB hard disk, $5,094. 1MB RAM upgrade, $490; 300MB hard disk, $2,600.

CIRCLE **651** ON READER SERVICE CARD

EDITOR'S CHOICE

Northgate Elegance 386/25
List Price: With 1MB RAM, 68MB hard disk, 1.2MB 5¼-inch and 1.44MB 3½-inch floppy disk drives, monochrome monitor, DOS 3.3, $3,999; with VGA monitor, $4,624; with 4MB RAM, 600MB hard disk, $11,394. 1MB RAM upgrade, $490.

CIRCLE **652** ON READER SERVICE CARD

In Short: The speed of these systems, combined with their high-quality components and documentation, merits anyone's consideration. The benchmark test results tell the real story of these quality 386s, though their refreshing warranty policy and other thoughtful measures help, too.

ELEGANCE 386/20 The drop in speed from the 25-MHz unit to the slower 20-MHz Elegance 386/20 was quite a bit more noticeable than I thought it would be. After the excesses of the Elegance 386/25, the low-end test 20-MHz system, with 2MB of memory, 64K of read/write-back cache, and a measly 80MB hard disk, felt almost boring. It is the benchmark test results that tell the real story, though. As with the 386/25, the FCC Class B–rated Elegance 386/20 surfaced second from the top without resorting to over-oscillated processors or any other feats of artful dodging.

The price of the tested system is right, too. Even when equipped with the same top-of-the-line VGA system as the 386/25, the tested system still costs a palatable $5,300.

Two 32-bit slots sit on the motherboard (along with six 16-bit), but with system board RAM capacity at 8MB, expansion RAM card capacity at 8MB and a total sys-

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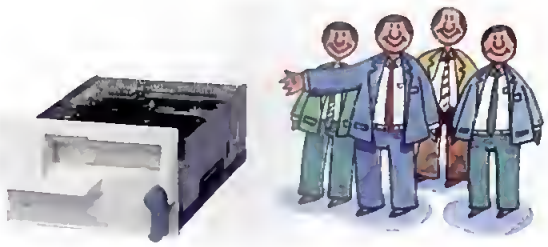

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tem capacity of 16MB of 32-bit memory, I honestly couldn't imagine what to do with the extra 32-bit crevasse.

ADDED APPEAL Other extras add to the appeal of both machines. Each came equipped with enough manuals and pamphlets to start your own reference library. The documentation that originates from Northgate is clearly illustrated and written in simple language.

Common to both computers is Northgate's warranty policy, which has some surprising terms. If a part breaks within 1 year of purchase, Northgate will ship out a replacement to you overnight (at its own expense) without your first needing to ship the defective unit back. The company is also currently negotiating an optional on-site service relationship with Sorbus Systems.

When it comes down to it, the speed of these systems, combined with high-quality components and documentation, would certainly earn them a place in my home, not to mention my office.—**Bill O'Brien**

OLIVETTI USA
OLIVETTI M380/XP1

Who says computers have to look boring? The gray-toned case of the Olivetti M380/XP1 defies such notions with a look reminiscent of European designer fashions. Olivetti has even attracted AT&T, whose less-ornamental computers are made by the Italian-based company.

Behind the pretty face, however, lies a 20-MHz computer that has a tough time living up to the promise of its outer appearance. For a base price of $6,995—no small change—you get 1MB RAM, an 80MB hard disk from Magnetic Peripherals, a 1.2MB floppy disk drive, and one parallel and one serial port. Our tested configuration included Olivetti's own VGA monitor with a 16-bit Paradise adapter card and an extra megabyte of RAM for a total list price of $8,579.

HIDDEN SWITCHES At the bottom front of Olivetti's 7¼-inch-high case lies a tiny, nearly invisible power-on switch. Beside it is an equally camouflaged reset button, a volume-control dial, a hard disk activity indicator, and a lock.

Olivetti's keyboard (it matches the case, of course) is well constructed and offers a firm touch. There's one problem, though: If you're short on desk space and need to push the keyboard against the computer, you'll find you've lost easy access to your power-on and reset switches. Also, the monitor plug doesn't fit into the computer's intended outlet.

Getting to the heart of the FCC Class B–certified M380/XP1 is another tricky matter. To overcome the limitations of the machine's small-footprint design, Olivetti has positioned its motherboard underneath the board housing the expansion slots, face down.

A 32-bit connector links the motherboard with the rest of the system. To get at the processor, Olivetti's BIOS, or the TTL chip set, you must turn the unit upside down and remove the bottom panel.

Three half-height drive bays, a 230-watt Alitec power supply with three connectors, and two 8-bit, two 16-bit, and three 32-bit expansion slots also lie within the attractive casing. Each 32-bit slot can hold a memory board fitting as much as 16MB, using 1-megabit SIMMs. (Our test system used 256-kilobit DRAM chips running at 100 nanoseconds.)

One caveat: If you're planning to run AT-compatible boards in the M380/XP1, you may hit trouble. This machine's bus speed is 10 MHz rather than a comfortable 8 MHz and may stymie an older board.

The Olivetti M380/XP1, with its decorative pattern and gray-toned case, sports real European flair. The outer trappings are marred by inefficient construction: the motherboard is placed facedown beneath the board holding the expansion slots.

SPEED VS. SLUGGISHNESS The Olivetti's Western Digital ST-506 controller led the machine to admirable results in PC Labs' BIOS Disk Seek benchmark test, where it finished in the top third. It also earned high marks in the DOS File Access benchmark tests.

But on those tests that relied on system architecture and memory speed, the Olivetti proved less impressive. Both the Conventional and Extended Memory tests found the machine wanting, zero wait states notwithstanding. And it ranked in the lower third on the 80386 Instruction Mix and Floating-Point Calculation tests.

With its M380/XP1 and other higher-end 386 models, Olivetti has been targeting the 386 market in the United States and Europe. But one obstacle it faces with the M380/XP1 is the paltry 90-day warranty period. The other is that there are plenty of other companies targeting the same market—and doing it better. If the company ever succeeds in matching its performance to its looks, the M380/XP1 is sure to turn heads. Right now, it's just beauty without brains.—**Susan L. Hayes and Edward L. Perratore**

PC MAGAZINE FACT FILE

Olivetti M380/XP1
Olivetti USA
765 U.S. Hwy. 202
Somerville, NJ 08876
(201) 526-8200
List Price: With 1MB RAM, 80MB hard disk, 1.2MB 5¼-inch floppy disk drive, $6,995; with monochrome monitor, DOS 3.3, $7,360; with VGA color monitor, $7,880; with 2MB RAM, $8,579. 1MB RAM upgrade, $699; 60MB tape backup, $1,237.
In Short: The Olivetti machine has a tough time living up to the promise of its designer-quality casing. Its Western Digital hard disk controller helped it to shine in some tests, but the machine proved disappointing in others.
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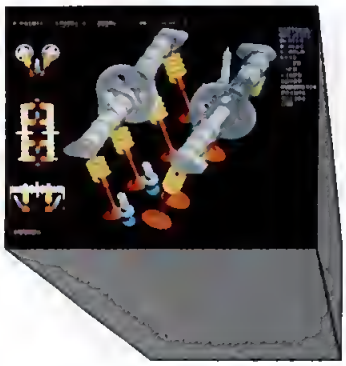

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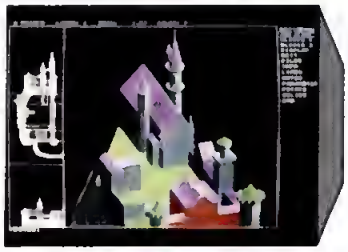

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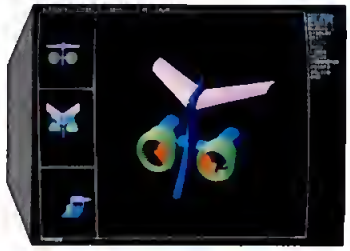
There is a very important reason to buy DesignCAD 3-D. PERFORMANCE. No other CAD system can match our price/performance ratio. Many people make the serious mistake of thinking that it is necessary to spend thousands of dollsrs to obtsin "s good 3-D CAD aystem." Thia is not truel We talk to people everyday thst are sadly disappointed with their "expensive" CAD systems. Don't be one of them! Call us snd we will send you s complete set of literature snd s free slide show demo disk. Once you compare DesignCAD 3-D veraion 2.0 with other CAD systems we know you will choose DesignCAD 3-D.



DON'T TAKE OUR WORD FOR IT

Here is what other people have to say about DesignCAD 3-D:

"After you've worked with DesignCAD, the single keystroke commands are simple to remember and it becomes easy to "flick one key" to execute s command. An extremely ergonomically designed program."

HENRY LEVET. Levet & Daigle Architects · New Orleans, LA
Designed a 65,000 sq. ft. nursing home using DesignCAD

"Recently I worked with s firm that builds decks. They purchased your product on my recommendation. I sat down with them and in two hours they were very proficient in DesignCAD. Now they are more effective; and we can communicate . . . it's wonderful to be able to do s block repeat 42 times snd there sre 42 2x4's to make the deck!"

J. TURNER, Architect, TAO Ltd. · The Woodlands, Texas

"Allows scientists and engineers to expend minimum time learning and using CAD software so that their time can be expended on the project at hand. It also allows acientists and engineers to quickly present to management all views of a subject. (3-D)."

DR. STEVENS, NASA Space Scientist/Engineer

HOW DO I GET ONE?

DesignCAD 3-D version 2.D is avsilable from most retail computer stores, or you may order directly from us. DesignCAD 3-D is available in a number of foreign languages from distributors throughout the world. All you need to run DesignCAD 3-D ia an IBM PC Compatible snd 64DK RAM. DesignCAD 3-D supports most graphics cards, printers, plotters and digitizers. Free information and a demo diskette are available by contacting us at:

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Small Businese Computers, Inc.
327 South Mill Street
Pryor, OK 74361
918/825-4844
FAX: 01-918-825-6358
TELEX: 8102400302

CIRCLE 475 ON READER SERVICE CARD

PAN-UNITED CORP.

MICROLAB 386/20
MICROLAB 386/25

A newcomer to the 386-based fray, Pan-United Corp. offers two systems with a range of configuration options, none of which involve questionable, no-name parts. The company's MicroLab 386/20 and 386/25 computers are equipped with respected, industry-standard components. Usually, when a vendor uses well-known entities, the prognosis for customer support and machine reliability is good.

Both the 20- and 25-MHz machines can be housed in either an AT-style desktop chassis or a monolithic tower. Both casings are of handsomely designed solid metal with plastic front-cover panels. The units, which received FCC Class B approval, sport the AT design blueprint—one internal full-height hard disk bay and a stack of three half-height bays on the top or the right, depending on the chassis orientation. The front-panel indicators include power-on and turbo LEDs (which show 8-MHz or high-performance clock speed) on both units, with an additional LCD on the 386/25.

The 386/20 and 386/25 come standard with unalterable zero wait states, 1MB of memory, 64K cache memory, and a 1.2MB 5¼-inch floppy disk drive, for base prices of $3,197 and $4,397, respectively. Both units can be configured with a variety of monitors, keyboards, and alternative disk drives. The systems we reviewed used top-notch brand-name components, including Micropolis ESDI high-capacity hard disks, TEAC floppy disk drives, Video Seven's much-acclaimed FastWrite VGA display adapters, Tatung monitors, and Key Tronics' Enhanced-style keyboards (with the clicky feedback that makes typing pleasurable). The prices for these configurations came to $5,432 for the 386/20 and $8,607 for the 386/25. The only proprietary part of the system is the power supply, a single-fan, 200-watt affair that includes a switch for either 110 or 220 volts.

Pan-United computers come with top-notch components.

The MicroLab machines contain the traditional expansion slots—one 8-bit and six 16-bit—as well as a proprietary 32-bit slot for expanded memory. Serial and parallel ports are located on the machines' Western Digital controller card.

AMI's motherboard and BIOS grace many of the more-reputable 386 machines, including Pan-United's MicroLab 386/25 (and its 20-MHz counterpart). Using 1-megabit chips, this motherboard can hold up to 8MB of RAM, divided between DIP and SIMM packs.

AMI MOTHERBOARD Like many of the more-reputable 386 machines on the market, the MicroLabs include AMI's motherboard and BIOS. The AMI board uses Chips and Technologies' chip set and contains sockets to support the Weitek or Intel 387 coprocessors, although neither of these is included.

The motherboard also reserves sockets for conventional DIP RAM chips and SIMM RAM chips. The DIP sockets will accommodate 1MB if you use 256-kilobit chips or 4Mb if you can get your hands on 1-megabit chips. The four SIMM banks can be filled in the same manner. Both the DIP and SIMM will also accommodate 4Mb chips (when they become available), but then you would have to choose between the DIP bank or the SIMM bank. Using the 4Mb chips, you could place up to 16MB on the motherboard and add another 16MB to the expansion card.

The cache memory uses the faster static-column RAM (SRAM); it offers increased performance where you need it most. The 386/25 uses 25-nanosecond SRAM; the 386/20, 20-ns. SRAM.

One of the nicest things about the AMI BIOS is that the diagnostics are built into ROM. When you power-up the machine, you can either use the CMOS setup program or run the comprehensive diagnostics to perform a low-level format on a hard disk or test the cache memory. The CMOS setup program can be used to enable shad-

PC MAGAZINE FACT FILE

Pan-United Corp.
1967 Rte. 27, #12
Edison, NJ 08817
(201) 985-8009
(800) 433-3006

MicroLab 386/20
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, $3,197; with 60MB hard disk, monochrome monitor, DOS 3.3, $4,077; with VGA monitor, $4,607; with 2MB RAM, 70MB hard disk, $5,432. 1MB RAM upgrade, $695; 150MB hard disk, $1,595; 60MB tape backup, $550.
CIRCLE 112 ON READER SERVICE CARD

MicroLab 386/25
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, $4,397; with 60MB hard disk, monochrome monitor, DOS 3.3, $5,277; with VGA monitor, $5,807; with 4MB RAM, 150MB hard disk, $8,607. 1MB RAM upgrade, $695; 150MB hard disk, $1,595; 60MB tape backup, $550.
CIRCLE 613 ON READER SERVICE CARD

In Short: Pan-United's MicroLab 386/20 and 386/25 use well-known top-of-the-line components that minimize the risks involved in buying mail-order AT clones. A combination of sturdy workmanship, AMI's respected motherboard and BIOS, and Video Seven's FastWrite VGA display adapter make the MicroLab machines good performers for price-conscious shoppers who want brand-name components.

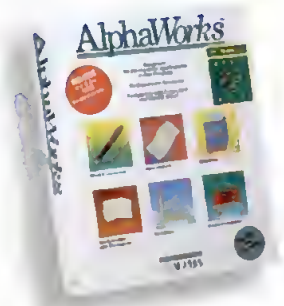
Writing some code?

☐ **3½" format available from us. Specify when ordering.**
◙ **package includes both 5¼" and 3½" disks.**
◘ **3½" format available from manufacturer by request. Call us for details.**
CP—copy-protected, **NCP**—not copy-protected.

SOFTWARE

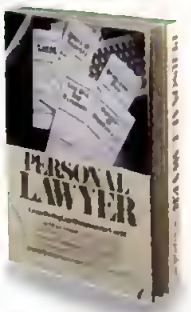
We only carry the latest versions of products. Version numbers in our eds are current at press time.

Aldus ... NCP
☐PageMaker 3.0 ..... call
Alpha Software ... NCP
◙AlphaWorks 1.0 *(integrated package)* .... 99.
☐ALPHA/four 1.0 *(dBF file compatible)*.... 319.
American Small Business Computers
☐Design CAD 3.1 *(NCP)*..... 159.
☐Design CAD 3D 1.1 *(NCP)*..... 159.



Alpha Software ... NCP
◙*AlphaWorks 1.0*–AlphaWorks, rated #1 by Software Digest, includes wp, spreadsheet, graphics, spell. & thes., and communications. It even reads and writes dBase III Plus and Lotus 1-2-3 files. A PC World "Best Buy!"..... $99.

Application Techniques ... NCP
◙Pizazz Plus 1.2 ..... 75.
Ashton-Tate ... NCP
☐dBASE IV 1.0..... call
◙MultiMate Advantage II 1.0 ..... 299.
Autodesk
☐Autosketch Standard 1.04 ..... 55.
Best Programs ... NCP
☐Label Master 3.1 *(mailing label program)*.. 29.
Bible Research ... NCP
☐The Word 4.2 *(King James version)* ..... 159.
☐The Word 4.2 *(New International version)*. 159.
Bloc Publishing ... NCP
☐FormTool 2.01..... 55.
☐Form Filler 2.0..... 89.
☐Personal Lawyer 2.0 ..... 39.
☐PopDrop 3.1..... 32.
Borland International ... NCP
◘Superkey 1.1..... 69.
◘Turbo C 2.0..... 99.
◘Turbo C Professional Pack *(w/Debugger)* ... 169.
◘Turbo Pascal 5.0 ..... 99.



Bloc Publishing ... NCP
☐*Personal Lawyer 2.0*–Personal Lawyer employs a quick and easy "question and answer" method to create on your PC a will, power of attorney or guardianship statement, promissory note, or residential real estate lease ..... $39.

◘Turbo Pascal Professional Pack *(w/Debugger)* ..... 169.
◘Prolog 2.0..... 99.
◘Turbo Assembler & Debugger 1.0 ..... 99.
◘Sidekick Plus 1.0..... 135.
◘Sprint 1.0..... 135.
◘Quattro 1.0 w/SQZ!Plus 1.0 ..... 165.
◙Paradox 3.0 ..... call
Bourbaki ... NCP
☐1DIR+ 3.0..... 49.
Bridgeway Publishing ... NCP
☐FastTrax 3.9..... 35.
Brodarbund ... CP
☐Print Shop 2.41 ..... 39.
◙Memory Mate 3.01R *(NCP)* ..... 45.
Chipsoft ... NCP
◘TurboTax Personal/1040 6.01..... 45.
Chronos Software ... NCP
◙Who•What•When *(people, projects, time)* 119.
Computer Associates ... NCP
◙SuperCalc 5..... 319.
Core International ... NCP
☐Corefast 2.0..... 95.
Crosstalk Communications ... NCP
☐Remote² 1.1 ..... 95.
☐Crosstalk XVI 3.7..... 95.
☐Crosstalk MK.4 1.1 ..... 124.
Dec Software ... NCP
☐Dac Easy Payroll 3.0..... 59.
☐Dac Easy Light 1.0 ..... 45.
☐Dac Easy Accounting 3.0 ..... 59.
Dataatorm ... NCP
☐Procomm Plus 1.1B..... 49.
Deirina Technology ... NCP
◙Per:FORM 1.0..... 159.
5th Generation ... NCP
◙Fastback Plus 2.01..... 109.
Fox Software ... NCP
◘Foxbase Plus 2.1 *(single user)* ..... 209.
◙Foxbase Plus 2.1 *(Natwork version)* ..... 319.
Funk Software ... NCP
☐Sideways 3.21 *(creates wide printouts)*.... 42.
◙Worksheet Utlities 1.0 *(1-2-3 utilities)* ..... 59.
☐Allways 1.0..... 85.

General Information ... NCP
◘Hot Line Two 2.0 ..... $49.
Generic Software ... NCP
◙Ganeric CADD Level 2 ..... 89.
◙Generic CADD Level 3..... 179.
◙Estimator..... 159.
◘Besic Home Design 3.0..... 35.
◘CADD Starter Kit *(Includes Level 2)* ..... 109.
Great American Software ... NCP
☐One Write Plus Master 2.01 *(General Ledger)* 129.
☐AP, AR, or Payroll 2.01..... each 129.
Harvard Associatea ... NCP
◘PC Logo 3.0 ..... 59.
Hayea ... NCP
◙Smartcom II 3.0..... 89.
◙Smartcom III 1.0 ..... 149.
Hilgraeve Software ... NCP
☐HyperACCESS 3.31 ..... 89.
Individual Software ... NCP
◙Typing Instructor Encore 2.13 ..... 26.
☐Professor DOS *(with Smartguide)*..... 27.
Intuit ... NCP
◙Quicken 2.1..... 35.
Javelin ... NCP
◘Javelin Plus 2.02..... 249.
Lifetree ... NCP
☐Volkswriter 4 ..... 159.
Lotua ... NCP
◙Agenda 1.0..... 289.
☐1-2-3 2.01 *(upgrade free to version 3.0)*... call
☐HAL 1.0..... 109.
☐Symphony 2.0..... 459.
☐Magellan 1.0..... call
☐Freelance Plus 3.0..... 345.
MECA ... NCP
◙Checkwrita Plus 1.0..... 29.
☐Managing Your Money 5.0..... 119.
Meridian Technology ... NCP
☐CarbonCopy Plus 5.0 *(2 required)* ..... 115.
Micro Logic ... NCP
☐Tornado 1.8..... 55.
Microlytics ... NCP
☐WordFindar 4.0..... 35.
☐GOfer 1.0 *(text retrieval system)*..... 45.

Harvard Associates ... NCP
◘*PC Logo 3.0*–PC Logo is the perfect companion for the Logo your children are learning in school. Encourage your child's creativity and critical thinking skills while sharing in the discovery of ideas at home ..... $59.

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☐ *CADD Level 3* is a sophisticated drafting package. The Generic Starter Kit includes CADD Level 2, Basic Home Design, as well as a workbook tutorial.

Generic CADD Level 3 ..... $179.
Generic CADD Starter Kit ..... 109.

MicroPro ... NCP
☐ WordStar Professional Release 5 ..... 209.
☐ *Upgrade to Release 5 from any version* ... 89.
Microrim ... NCP
◙ R:BASE for DOS *(version 2.1)* ..... 489.
◙ R:BASE Compiler ..... 629.
Microsoft ... NCP
☐ Learning DOS 2.0 *(for any DOS version)* .. 35.
☐ Windows 286 2.1 ..... 69.
☐ Works 1.05 ..... 99.
◙ Windows 386 2.1 ..... 129.
◙ Word 5.0 ..... call
◙ Excel 2.1 *(requires 80286/80386 CPU)* .. 239.
LANGUAGES
☐ Quick BASIC 4.5 ..... 69.
☐ Quick C 2.0 ..... 69.
◙ Macro Assembler 5.1 ..... 99.
◙ Basic Compiler 6.0 ..... 199.
◙ C Compiler 5.1 ..... 299.
Monogram ... NCP
◙ Dollars and Sense 3.1 ..... 105.
Multisoft ... NCP
☐ Super PC Kwik 3.2 *(disk cache utility)* .... 49.
☐ Super PC Kwik Power Pak 1.1 ..... 59.
Nantucket Software ... NCP
◙ Clipper *(Summer '87, dB3 Plus compiler)* 429.
New England Software ... NCP
◙ Graph-in-the-Box Release 2. ..... 75.
☐ GB-Stat 1.0 ..... 159.
◙ GB Analytic 1.0 ..... 105.
Nolo Press ... NCP
☐ WillMaker 3.0 ..... 35.
☐ For The Record 1.0 ..... 35.
North Edge Software ... NCP
☐ Timeslips III 3.3 ..... 169.
Owl International ... NCP
☐ Guide 2.0 ..... 143.
Paperback Software ... NCP
☐ VP-Info 1.4 ..... 65.
☐ VP-Plenner Plus 2.0 ..... 145.
☐ VP-Expert 2.02 ..... 145.
Paul Mace ... NCP
☐ Nvelope 1.02. ..... 29.
☐ HTest—HFormat 2.0 ..... 49.
☐ Mace Utilities 5.0 *(DOS utilities)* ..... $55.
☐ Mace Gold 1.0 ..... 79.
PC Support Group ... NCP
☐ Lightning 4.82. 39
☐ Lucid 3-D 2.0 ..... 75.
Parsonics ... NCP
☐ SmertNotes 2.0 ..... 49.
☐ SeeMORE 1.02 ..... 49.
☐ Look&Link 1.01 ..... 59.
☐ Ultravision 1.1 ..... 79.
Peter Norton ... NCP
◙ Norton Editor 1.3. ..... 39.
◙ Norton Commender 2.01. ..... 45.
◙ Standard Utilities 4.5 ..... 55.
◙ Advanced Utilities 4.5 ..... 79.
◙ Dan Bricklin's Demo Program 2. ..... 99.
Quarterdeck ... NCP
☐ Expanded Memory Manager 4.2. ..... 39.
☐ DESQView 2.2. ..... 79.
☐ DESQView 386 1.0. ..... 115.
Reference Software ... NCP
☐ Grammatik III 1.07 *(electronic proofreader)* 52.
☐ Reference File 1.0 *(pop-up DB manager)*. . 49.
Relay Communications
☐ Relay Gold 3.0. ..... 149.
Revolution Software ... NCP
◙ VGA Dimmer 2.01 *(screen saver)* ..... 19.
◙ Cruise Control 3.02 ..... 39.
Rightsoft ... NCP
☐ Rightwriter 3.0. ..... 54.
Simon & Schuster ... NCP
☐ Typing Tutor IV. ..... 33.
Softlogic Solutions ... NCP
☐ Software Carousel 3.0 ..... 49.
☐ Disk Optimizer 4.01 *(w/Data Guardian)* ... 45.
◙ FATCAT 1.0 ..... call

North Edge Software ... NCP

☐ *Timeslips III 3.3*—Turns time into money for your service business with its accurate software timer, custom billing system, powerful productivity analysis and accounts receivable reports ..... $169.

Software Publishing ... NCP
◙ Professional Plan 1.01 ..... $59.
☐ PFS:First Publisher 2.0 ..... 79.
◙ PFS:First Graphics 1.0. ..... 95.
◙ PFS:First Choice 3.01 ..... 99.
◙ Professional Write 2.1 ..... 145.
◙ Professional File 2.0. ..... 189.
◙ Office Writer 6.1. ..... 299.
◙ Harvard Grephics 2.12 ..... 299.
◙ Harvard Grephics Accessories Peck .... 299.
◙ Harvard Project Maneger 3.0 ..... 439.
Spinnaker ... NCP
☐ Resume Kit 1.0 ..... 25.
☐ 8-in-1. ..... 39.
◙ Splash 1.0. ..... 59.
Springboard ... NCP
☐ Newsroom Pro 1.0. ..... 45.
Symantec ... NCP
◙ SQZ!Plus 1.11 ..... 69.
◙ Q & A Write 1.01 ..... 135.
◙ Grandview 1.0. ..... 195.
☐ Q & A 3.0 *(database, word processor)* ... 235.

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◙ Spreadsheet Analyst 2.5 ..... 99.
◙ Think Tank 2.41NP. ..... 135.
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◙ Scrapbook+ 1.0 ..... 79.
◙ ClickArt Business Images ..... 42.
◙ EPS (PostScript) Illustrations ..... 79.
The XTREE Co. ... NCP
◙ XTREE Pro 1.1 ..... 69.
TOPS ... NCP
Flashcerd (AppleTalk network card; 1 year warranty). ..... 169.
NetPrint 2.0 *(share printers)* ..... 119.
TOPS 2.0 ..... 119.
TOPS Repeater *(extends network)* ..... 132.
Traveling Software ... NCP
Battery Watch 1.0 *(3½" only)*. ..... 27.
◙ LapLink Mac 2.0 *(Mac-PC transfer)* ..... 79.
◙ LapLink Plus 2.1 ..... 85.
◙ ViewLink 1.0 *(first product to link all your existing software programs and data)* .... 95.
◙ DeskLink 2.21 ..... 99.

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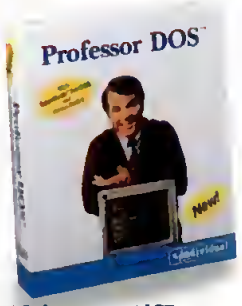

Individual Software ... NCP

☐*Professor DOS*–Professor DOS offers the most comprehensive, up-to-date information and has trained over 1 million people on everything you need to know to use your PC's disk operating system efficiently..... $27.

True BASIC, Inc. ... NCP
☐True BASIC 2.1 *(now includes Runtime)* . . . 57.
◧3-D Graphics. . . . . 45.
Vericomp ... NCP
◙SoftBytes 2.0 . . . . . 35.
WordPerfect Corp. ... NCP
◙WordPerfect Library 2.0. . . . . 69.
◙WordPerfect Executive. . . . . 129.
☐WordPerfect 5.0. . . . . 239.
◙WordPerfect Office 2.0. . . . . 269.
◧WordPerfect Network 5.0. . . . . 349.
◧Additonal Network Stations 5.0 . . . . . 84.
Wordtech ... NCP
☐DBXL 1.2. . . . . 119.
Xerox ... NCP
☐Ventura Publisher 2.0 . . . . . call
XYQUEST ... NCP
☐XyWrite III Plus 3.54 w/A-la-Carte Menus . 229.

RECREATIONAL/EDUCATIONAL

Accolade ... CP *(reqs. graphics brd.)*
◧Hardball *(baseball simulation)* . . . . . 11.
◧Testdrive *(driving simulation)* . . . . . 22.
◧Jack Nicklaus' 18 Greatest Holes. . . . . 29.
◧Grend Prix. . . . . 22.
Barron's ... CP
◧SAT *(Test preparation program)* . . . . . 35.
Broderbund ... CP
◧Where in the World is Carmen Sandiego? . 25.
◧Where in the USA is Carmen Sandiego? . . 25.
◧Where in Europe is Carmen Sandiego? . . . 29.
☐JetFighter *(by Velocity)*. . . . . 35.
Electronic Arts ... CP *(reqs. graphics brd.)*
◙Chessmaster 2100. . . . . 35.
◙Life end Death *(from Softwara Toolworks)*. . 35.
◙Chuck Yeager's Flight Trainer 2 . . . . . 35.
☐688 Attack Sub . . . . . 35.
☐Megic Cendle . . . . . 35.
Microprose ... CP
☐F-19 Stealth Fighter *(requires CGA or EGA)* 39.
☐F-15 Strike Eagle *(requires CGA)* . . . . . 22.
Microsoft ... NCP
☐Flight Simulator 3.0 *(reqs. graphics brd.)* . . 35.
Mindscape ... CP
☐Geuntlet . . . . . $29.
◧Paperboy . . . . . 29.
☐Colony 1.0. . . . . 30.
◧Balence of Power 1990 . . . . . 30.
Parlor Software ... CP
☐Bridge Parlor 2.3. . . . . 49.
Sierra On-Line ... CP
(All require Hercules, CGA or EGA)
◙Leisure Suit Larry II . . . . . 33.
◙King's Quest IV *(512k version)* . . . . . 33.
◙Menhunter . . . . . 33.
◙Police Quest II . . . . . 33.
◙Space Quest II. . . . . 33.
◙Gold Rush. . . . . 25.
Spectrum Holobyte ... NCP
◙Tetris *(eddicting mind teaser)* . . . . . 24.
◙Falcon/AT *(F-16 simulation, reqs. graph. brd.)* 32.
Stone & Assoc. ... NCP *(reqs. greph. brd.)*
◧Memory Master *(eges 2 to 6)* . . . . . 22.
◙My Letters,Numbers,Words *(2 to 6)* . . . . . 22.
☐2nd Meth *(eges 7 to 16)*. . . . . 27.

Electronic Arts ... CP

☐*688 Attack Sub/Magic Candle*–Experience full-perspective color graphics while taxing your strategical and tactical thinking.
Magic Candle from Miles Computing.....$35.
688 Attack Sub from Electronic Arts.....35.

Sublogic ... NCP
☐Jet 2.1 *(requires EGA or CGA)* . . . . . 33.
☐Up Periscope. . . . . 25.
True BASIC, Inc. ... NCP
◧Kemeny/Kurtz Math Series . . . . . 32.
XOR ... NCP
☐NFL Challenge 2.0 . . . . . 69.

HARDWARE

Manufacturer's standard limited warranty period for items shown is listed after each company name. Some products in their line may have different warranty periods.

AST Research ... 2 years
I/O Mini 2 C/S/P. . . . . 89.
SixPakPlus 64k C/S/P *(upgrades to 576k)* 129.
Advantage Premium 512k S/P . . . . . 429.
RAMpage Plus 286 512k *(for XT286/AT)*. . 539.
RAMpege Plus MicroChennel 512k. . . . . 539.
Compucable ... 2 years
2-Position switch box. . . . . $29.
3-Position switch box. . . . . 39.
Cuesta ... 1 year
Detasaver 400 Watt
(standby power backup) . . . . . 459.
Curtis ... lifetime
Curtis Clip CC-1. . . . . 6.
Disk Holder DB-1 *(holds 50 5¼" disks)*. . . . 8.
3½" Disk Holder DB-2 *(holds up 40 disks)* . 8.
Printer Stand PS-1 . . . . . 18.
Universal System Stand SS-3. . . . . 25.
Smartmodem-to-PC Cable EC-7 *(9 feet)*. . . 17.
Printer-to-IBM cable EC-6 *(9 feet)*. . . . . 17.
Filtered SafeStrip SPF-3 . . . . . 21.
Emerald SP-2 . . . . . 36.
Ruby SPF-2
(6 outlets; EMI/RFI filtered; 6 ft cord). . . . . 55.
Ruby-Plus SPF-2 Plus
(w/FAX & modem protection) . . . . . 69.
DCA ... 1 year
Irma 2 *(3270 emulation board)*. . . . . 729.
Irma 2 Micro Channel . . . . . 729.
Epson ... 1 year
We are an authorized Epson Service Center.
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FX-1050 *(136 col., 264 cps, 9 pin)* . . . . . call
LQ-500 *(80 col., 180 cps, 24 pin)*. . . . . 295.
LQ-850 printer *(80 col., 264 cps, 24 pin)* . . call
LQ-950 printer *(110 col., 264 cps, 24 pin)* . call
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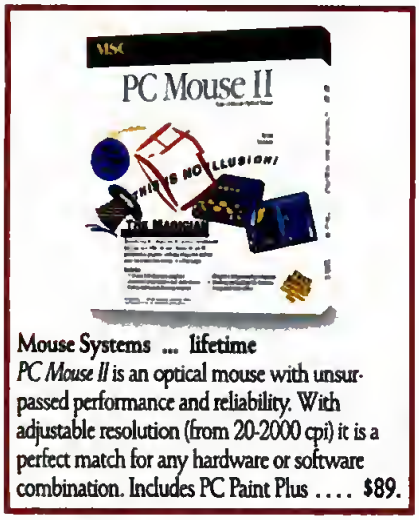

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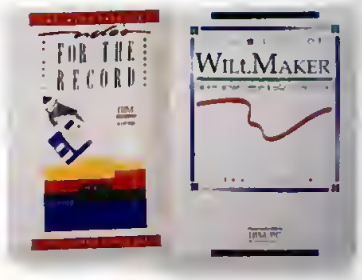

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A lot's changed around here since we first began selling products for the PC in 1982. Back then, our warehouse was in a closet, orders were filled by hand, and the dam on the nearby Ashuelot River was badly in need of repair. But even though we now have a much larger warehouse, the most sophisticated order processing system in micro mail order, and one of the most solid dams in New Hampshire, we're still country boys, girls, (and animals) at heart.

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ow RAM, which essentially copies the ROM-based video drivers to RAM for faster execution.

Although you'll have to lay out an additional $95 for DOS, the machines do come with a fair amount of software, including *SEEMS 386*, AMI's emulation of the LIM EMS 4.0 expanded memory. If you buy a hard disk with more than 40MB, the company throws in *Disk Manager*, a hard disk diagnostics and partitioning utility. Perhaps the highlight of the system is the FastWrite VGA and its accompanying software. Together, the display adapter and shadow RAM are high-power performers.

Those who prefer just to use their PCs, not explore them, will appreciate having machines that are "C-prompt ready." The hard disk drives come low- and high-level formatted with DOS 3.3.

With configuration options culled from a variety of established manufacturers, the MicroLabs won't win prizes for original thinking or design. But Pan-United does offer a nice, safe foray into the 386 world. **—Robin Raskin**

PC DESIGNS INC.
PC DESIGNS 386-20 PLUS

Since our review of PC Designs' 16-MHz GV-386 in our December 1987 roundup of fast and affordable 386-based PCs, we haven't heard much from the folks at the company. Most likely they've been cloistered away, earnestly upgrading and enhancing an already good-quality machine.

The result of their efforts is the desktop-sized PC Designs 386-20 Plus. Like its predecessor, the Plus (base-priced at $2,799) is a well-designed machine—only this version comes packed with 20 MHz of processing power and a few other interesting enhancements.

At $11,215, the fully loaded test configuration is competitive with other 386 machines. This price includes a serial/parallel port card, an additional serial port, a 16-bit Paradise VGA adapter, a 155MB Control Data hard disk, 1.2MB and 1.44MB floppy disk drives, an Adaptec ESDI controller, 1MB of 32-bit RAM on the motherboard, and an add-in memory board with a generous 8MB more. A NEC MultiSync II monitor and a 101-key Maxiswitch keyboard were also included. The test configuration did not include a tape drive, but a Wangtek 60MB tape cartridge drive is available through PC Designs.

The FCC Class A–certified unit is equipped with a 200-watt power supply from Fortron and is designed to hold three accessible half-height drives plus two internal half-height or one internal full-height disk drive.

HOMEMADE MOTHERBOARD

Although you can choose to configure your machine with a variety of components, most of which are manufactured by other companies, at the heart of the 386-20 Plus is PC Designs' very own Model 32 motherboard.

The standard Model 32 motherboard contains a 386 chip switchable between 10 and 20 MHz and a maximum of only 1 MB of 32-bit, 256-kilobit, 100-nanosecond DRAM. It also provides you with 64K cache memory using fast 35-ns. SRAM modules, as well as eight expansion slots: two 32-bit, two 8-bit, and four 16-bit. The limited memory capacity of the motherboard can be compensated for by filling both 32-bit slots with memory boards that take up to 8MB of RAM each, bringing 32-bit system memory up to the rather odd sum of 17MB.

PC Designs' 386-20 Plus uses a proprietary motherboard that supports the Intel 80387 coprocessor as well as the Weitek 3167 and 1167 modules. The motherboard takes a maximum of 1MB of RAM, but both 32-bit slots can be filled with 8MB worth of memory cards.

One of the more interesting features of the 386-20 Plus, and an upgrade from the GV-386, is having Intel 80387 math coprocessor support on the motherboard. In addition, the motherboard is capable of supporting the Weitek 3167 and Weitek 1167 modules. In fact, the tested system was equipped with both the Intel and the Weitek 1167. If you have a program that can take advantage of a Weitek module, you simply turn the module on by following the accompanying software's instructions.

Speedwise, in zero-wait-state mode, the 386-20 Plus scored above average on the 80386 Instruction Mix, Conventional Memory, and Extended Memory benchmark tests. In contrast, it received a below-average score for the small-record DOS File Access test and an average score for the large-record DOS File Access test. The 386-20 Plus also scored poorly in the BIOS Disk Seek test.

Overall, PC Designs' latest effort effectively integrates brand-name components and a proprietary motherboard to yield generally swift and solid performance. If you're in the market for a 386, this system is worth a look. **—Stephanie Izarek**

PC MAGAZINE FACT FILE

PC Designs 386-20 Plus
PC Designs Inc.
2500 N. Hemlock Circle
Broken Arrow, OK 74012
(918) 251-7503
(800) 322-4872
List Price: With 1MB RAM, 5¼-inch floppy disk drive, $2,799; with 60MB hard disk, monochrome monitor, DOS 3.3, $3,652; with VGA monitor, $4,405; with 8MB add-in board, $7,405. 155MB hard disk, $1,799; 60MB tape backup, $669.
In Short: Although the PC Designs 386-20 Plus doesn't offer any earth-shaking new technology, it is a well-designed, competitively priced 20-MHz machine that offers all the processing power, upgrade potential, and virtually limitless possibilities you could want in a 386-based computer.
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CIRCLE 298 ON READER SERVICE CARD

PC LINK CORP.
PC LINK 386-16
PC LINK 386-20

It's hard to see how you could go wrong with one of PC Link's computers. All the electronic components are made in the U.S., and the systems' performance will satisfy anyone who won't despair if he doesn't own a speed champion. The workmanship is the best you can find, short of IBM, and—considering the quality—the price is right.

The $1,895 base configuration of the 16-MHz PC Link 386-16 comes with 1MB of 100-nanosecond RAM on the motherboard, a 220-watt Tri-Mag power supply, a 1.2MB Toshiba floppy disk drive, a floppy/hard disk controller, an Everex card with serial and parallel ports, and a Key Tronics Enhanced-style keyboard. A similarly configured 20-MHz PC Link 386-20, with 1MB of 80-ns. RAM, goes for $400 more. MS-DOS 3.3 adds $95 to the price; 4.01 adds $119.

Externally there's no difference between PC Link's 16- and 20-MHz machines. Both come in sturdy AT-size desktop cases with three open half-height bays. The front panel offers a key lock, indicator lights, and a reset switch.

At the heart of each machine is the reliable and handsome Hauppauge Computer Works 386 motherboard. Near the front of the motherboard are 1MB of 256-kilobit chips, the 80386, and a socket for an 80387. The motherboard doesn't use on-board cache, but its memory is four-way interleaved, and the ROM BIOS and video BIOS can be moved into shadow RAM.

Our tests showed that the 16-MHz model generally performs at the faster end of the spectrum. The early model of the 20-MHz motherboard we tested performed somewhat less impressively, but PC Link plans to ship an improved version with the 386-20.

On the left side of the motherboard in each unit is a proprietary 32-bit slot for Hauppauge's memory cards; you can add up to 14MB of RAM to the 16-MHz model, 64MB to the 386-20. Next are three 8-bit slots followed by four 16-bit slots. Five knockouts on the back panel let you mount extra ports without wasting slots.

For compatibility's sake, the Hauppauge motherboard keeps things sane and simple. Unless you run a TSR that lets you throttle back by pressing Ctrl-Alt-Minus, the board runs at only one speed. You can configure the Award BIOS by pressing Ctrl-Alt-Esc before DOS starts to boot, but those keys have no effect when you're running DOS or an application. A setup program on-disk is always available from the DOS prompt, and a configuration program lets you add two custom entries to the hard disk parameter table. For fancier memory management, a copy of Quarterdeck's *QEMM-386* utility is included.

The components are good enough to make you forget about the 1-year parts-and-labor warranty. For monochrome systems, PC Link sells the Hercules Graphics Card Plus; for color systems, the Video Seven VGA card or the 16-bit Video Seven VRAM VGA card. PC Link offers about ten different flavors of hard disks and Sysgen tape backup units. If you don't like the mushy feel of the Key Tronics keyboard, you can have a clickier Chicony model. And the Hauppauge motherboard is so thoughtfully designed that you can even plug in the old PC- or XT-style keyboard and make a quiet protest against the "Enhanced" standard imposed by IBM.

The 16-MHz machine tested in PC Labs came with a Miniscribe 40MB hard disk connected to an NCL controller. The 20-MHz machine had CDC's 90MB ESDI disk connected to a Western Digital controller and also included a 1.44MB Toshiba floppy disk drive. Both machines were fitted with Video Seven's 16-bit VRAM VGA card and NEC MultiSync II monitors, and each included a 2MB memory card fitted with 1MB of RAM.

PC Link's computers don't have the kind of streamlined cases, LED displays, or exotic hardware that will make your friends envy you for a few months—until the next fancy machine hits the streets. But if you buy one, you'll probably feel quietly proud of your good sense and eye for quality.—**Edward Mendelson**

High-quality workmanship and U.S.A.–made, brand-name electronic components are hallmarks of the sturdy PC Link 386-16 and 386-20 systems. Among the components of the desktop-AT-style 386-20 were Hauppauge Computer Works' reliable 386 motherboard, which runs mostly at one speed.

PC MAGAZINE FACT FILE

PC Link Corp.
29 W. 38th St.
New York, NY 10018
(800) 221-0343
(212) 730-8036

PC Link 386-16
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, $1,895; with 70MB hard disk, monochrome monitor, DOS 3.3, $2,950; with VGA monitor, $3,450; with 2MB RAM, 40MB hard disk, 80387 coprocessor, $4,795. 1MB RAM upgrade, $995; 150MB hard disk with ESDI controller, $1,600; 60MB tape backup, $659.

CIRCLE **623** ON READER SERVICE CARD

PC Link 386-20
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, $2,295; with 70MB hard disk, monochrome monitor, DOS 3.3, $3,350; with VGA monitor, $3,850; with 2MB RAM, 90MB hard disk, 1.2MB 5¼-inch and 1.44MB 3½-inch floppy disk drives, 80387 coprocessor, $6,375. 1MB RAM upgrade, $1,095; 150MB hard disk with ESDI controller, $1,600; 60MB tape backup, $659.

CIRCLE **624** ON READER SERVICE CARD

In Short: PC Link's computers, built around the Hauppauge motherboard, use the highest-quality components, run at good or better speed, and offer all the options that anyone except a hot-rodder could ask for. At $1,895 for a 16-MHz base system without hard disk and video, the price is better than reasonable.

386-based PCs: Summary of Features

The following commentary analyzes some of the terms in this table of features. The phrases in bold type are listed in the same order as in the left-hand column of the table.

Basic configuration This price represents the most-stripped-down machine the vendor will sell, typically including 1MB RAM, one floppy disk drive, and serial and parallel ports. Note that these prices are not always strictly comparable because some vendors will not sell their computers without a hard disk or with less than 2MB RAM. Therefore, when comparing products, please consult the "standard configuration" prices as well. (All prices in this features table are subject to change.)

Cost of DOS 3.3/OS/2 DOS is sometimes included in the basic configuration; in other cases, it has a separate price. OS/2 can sometimes be purchased with a system, but it is not available from all vendors.

Hard disk options For buyers seeking specific configurations, some vendors offer more flexibility than others. The number of different hard disks the vendor offers for a machine is often indicative of how much customizing is available. Keep in mind that it is sometimes far more cost-efficient to buy your computer and hard disk from different vendors.

Reset switch Many computers now come with a reset switch allowing a cold reboot of the computer. This switch saves wear and tear on the power switch.

Standard configuration For the sake of price comparisons, our "standard" configuration normally includes 1MB RAM, a 60MB hard disk, at least one floppy disk drive, a monochrome monitor, at least one parallel and one serial port, DOS, and a keyboard. Because the closest approximation of our standard package may differ from this configuration, the price of each system is followed by the total RAM (if the package includes more than 1MB) and the size of the hard disk (if other than 60MB). Where no price appears, the vendor does not sell a system that conforms to at least five of the parameters we have designated for a standard machine—which means merely that the reader will have to use other information in comparing prices.

Tested configuration The specifications of the evaluation units depend on what configuration each manufacturer has sent us (based on our guidelines). The **list price** cited always includes DOS.

Bus clock speeds Bus speed becomes more important as computers run at faster clock speeds. A computer's bus speed may actually be too fast for expansion cards, most of which operate at 8 or 10 MHz. Time-out periods, sometimes called wait states, are often used to slow down the bus.

Disk controller manufacturer and type (interface/encoding) Several interfaces are used to control the way data is transferred from the hard disk to the computer. The most common disk interface standard is the ST-506/412, used in the IBM PC-XT and PC AT. Two other common data transfer interfaces are SCSI (Small Computer System Interface) and ESDI (Enhanced Small Device Interface). Both SCSI and ESDI require special hard disk controllers and cannot run off existing PC-XT or PC AT controllers.

Disk encoding techniques currently include RLL (Run Length Limited) and the older MFM (Modified Frequency Modulation) schema. All data is encoded onto and read from your hard disk as a series of polarity-reversing bits representing ones and zeros. Nine such bits would be needed to store 12 bits of data in MFM format, and only six polarity changes are required with RLL format; thus, MFM takes more space than RLL but provides a more stable environment and is more commonly used. ST-506 technology, for instance, uses the MFM encoding schema.

BIOS version and date The BIOS date is important to those planning to use 3½-inch disk drives. Early BIOS versions cannot handle this format. (In some cases the vendor would not release this information.)

Memory chip type In this context, Kb and Mb refer to kilobits and megabits, respectively.

Chip packaging Memory chips come in a variety of styles: DIPs, SIPs, and SIMMs. The Dual In-line Package (DIP) is the traditional bug-like computer chip sprouting 8, 14, 24, or even 40 or more metal legs (evenly divided between right and left sides). Single In-line Packages (SIPs) are single-package arrays of computer chip logic assembled so that all connecting legs are in a straight line, like the teeth on a comb. Single In-line Memory Modules (SIMMs), on the other hand, are individual logic devices that are installed on their own small circuit board, creating a component module that can be plugged into a larger device. Their physical arrangement duplicates the integrated structure of a SIP but allows for the possibility of replacing an individual memory component if necessary.

RAM chips RAM chips come in two basic types: static and dynamic. Static RAM chips (SRAMs) are faster and more efficient but costlier. Dynamic RAM chips (DRAMs) cost less and are more common, but the trade-off is in slower processing and operation.

Static column RAM uses SRAM chips arranged electrically as pages (using column address) rather than as individual words or bytes (using row address). Paging is desirable because the 80386 contains a prefetch instruction that allows it to deal with a full page of RAM.

Interleaved memory CPU speed is usually faster than memory speed. Interleaved memory increases processing speed by splitting the memory into two or more portions. The CPU then sends information to a section at a time, allowing one section to process while another receives data.

Shadow RAM Shadow RAM is a technology that loads system BIOS and/or video BIOS directly into fast RAM on boot-up of the computer. The BIOS then operates much faster.

Disk cache software Some companies provide their own software to facilitate caching. Other computers can generally take advantage of the caching facility within some version of DOS.

Maximum 32-bit RAM There is currently no standard for 32-bit cards, and not many cards are available today. Many computer manufacturers, however, have designed their own 32-bit slots for memory expansion cards. The availability of 32-bit slots for memory cards is especially important in the era of OS/2, a memory-hungry operating system.

FCC certification class Two classes of FCC (Federal Communications Commission) approval may be given to computers: Class A and Class B. These classes concern levels of radio-frequency interference. With Class A approval, a computer may be operated in a business locale. The tougher Class B rating allows home use as well, where computers are likely to be placed near radios and television sets.

Certification tests must be performed by private testing companies. The passing results are then sent to the FCC for final certification, a process that can take several months.

386-based PCs: Summary of Features

	Acer Technologies Corp.			Advanced Logic Research Inc.		Altec Technology Corp.	
BASIC CONFIGURATION	Acer 1100/16	Acer 1100/20	Acer 1100/25	ALR FlexCache 20386DT	ALR FlexCache 25386	Altec ZIP-386/16	Altec ZIP-386/20
List price	$3,195	$3,945	$6,295	$2,695	$9,499	$1,595	$1,845
Basic configuration includes	2MB RAM, 1.2MB floppy disk drive, two serial and one parallel port, DOS 3.3, *Microsoft Windows/386*	2MB RAM, 1.2MB floppy disk drive, two serial and one parallel port, DOS 3.3, *Microsoft Windows/386*	2MB RAM, 1.2MB floppy disk drive, two serial and one parallel port, DOS 3.3, *Microsoft Windows/386*	1MB RAM, 1.2MB floppy disk drive, one serial and one parallel port	4MB RAM, 150MB hard disk, 1.2MB floppy disk drive, VGA card, one serial and one parallel port	1MB RAM, 1.2MB floppy disk drive, one serial and one parallel port	1MB RAM, 1.2MB floppy disk drive, one serial and one parallel port
Drive bays	5 half-height	5 half-height	5 half-height	5 half-height	6 half-height	5 half-height	5 half-height
Cost of DOS 3.3/ OS/2 (if available)	Included/$325	Included/$325	Included/$325	$160/ Unavailable	$160/ Unavailable	$75/ Unavailable	$75/ Unavailable
Hard disk options	8	8	8	3	2	8	8
Slots	Two 8-bit, five 16-bit, one 32-bit	Two 8-bit, five 16-bit, one 32-bit	One 8-bit, six 16-bit, two 32-bit	Two 8-bit, four 16-bit, two 32-bit	One 8-bit, six 16-bit, one 32-bit	Two 8-bit, five 16-bit, one 32-bit	Two 8-bit, five 16-bit, one 32-bit
Slots free with hard and floppy drives, video, two serial and one parallel port installed	5	5	5	5	5	4	4
Power supply (watts)	200	200	230	200	200	285	275
Reset switch	Front	Front	Front	None	None	Front	Front
Keyboard cable length (inches)	96	96	96	72	72	60	60
STANDARD CONFIGURATION							
Price of monochrome system with 1MB RAM, 60MB hard disk, DOS	$4,600 (2MB RAM, 70MB disk)	$5,350 (2MB RAM, 70MB disk)	$8,250 (2MB RAM, 70MB disk)	$4,319 (66MB disk)	N/A*	$2,195	$2,445
Price of VGA system	$5,305 (2MB RAM, 70MB disk)	$6,055 (2MB RAM, 70MB disk)	$8,955 (2MB RAM, 70MB disk)	$5,013 (66MB disk)	N/A*	$2,795	$3,045
TESTED CONFIGURATION							
List price	$5,954	$8,382	$10,017	$6,884	$10,444	$2,995	$3,245
Tested configuration includes	4MB RAM, 70MB hard disk, 1.2MB floppy disk drive, VGA monitor, mouse	4MB RAM, 150MB hard disk, 1.2MB floppy disk drive, VGA monitor, 80387-20 coprocessor, mouse	4MB RAM, 150MB hard disk, 1.2MB floppy disk drive, VGA monitor, mouse	2MB RAM, 120MB hard disk, 1.2MB floppy disk drive, VGA monitor	4MB RAM, 150MB hard disk, 1.2MB and 1.44MB floppy disk drives, VGA monitor	2MB RAM, 43MB hard disk, 1.2MB and 1.44MB floppy disk drives, VGA monitor	2MB RAM, 65MB hard disk, 1.2MB and 1.44MB floppy disk drives, VGA monitor
Microprocessor clock speeds	4.77/6/8/16 MHz	4.77/6/8/20 MHz	6/8/25 MHz	10/20 MHz	10/25 MHz	6/8/16 MHz	6/8/20 MHz
Bus clock speeds	8 MHz	8 MHz	8 MHz	10 MHz	8 MHz	8 MHz	10 MHz
Wait states	2	0	0, 1	0	0	0	0
Disk controller manufacturer and type (interface/encoding)	Western Digital (ST-506/MFM)	DTC (ESDI)	DTC (ESDI)	Western Digital (ESDI)	Western Digital (ESDI)	Western Digital (ST-506/MFM)	Data Technology (ST-506/RLL)
Number of drives handled by controller	4	4	4	4	4	4	4
BIOS version and date	Acer 386 BIOS, Version 2.2	Acer 386 BIOS, Version 2.2	Award BIOS, Version 3.03	Phoenix ROM BIOS Plus (September 1988)	Phoenix ROM BIOS Plus (September 1988)	Phoenix BIOS, Version 1.10.03 (January 1988)	Award BIOS, Version 3.3 (1988)
System board manufacturer	Acer	Acer	Acer	ALR	ALR	Micronics	Micronics
386 chip set manufacturer	Intel	Intel	Intel	None (uses discrete logic)	None (uses discrete logic)	Intel	Intel
MEMORY SPECIFICATIONS							
Memory chip type	1Mb	256Kb	1Mb	256Kb	256Kb, 1Mb	1Mb	1Mb
Chip packaging	DIP	DIP	SIMM	DIP	DIP	DIP	DIP
RAM chips	DRAM	DRAM	DRAM	DRAM	DRAM	Static column RAM	Static column RAM
Interleaved memory	●	●	○	○	○	○	○
Shadow RAM	BIOS and video	BIOS and video	BIOS and video	BIOS and video	BIOS and video	BIOS and video	BIOS and video
Type of cache controller	None	None	Intel 82385 (32K)	Intel 82385 (32K)	ALR (64K)	None	None
Disk cache software	○	○	●	●	●	○	○
Maximum RAM on motherboard	4MB	4MB	8MB	2MB	4MB	N/A**	N/A**
Maximum 32-bit RAM	16MB	16MB	40MB	10MB	16MB	10MB	10MB
Maximum total system RAM	16MB	16MB	40MB	16MB	16MB	16MB	16MB
OTHER							
Warranty	1 year; 4 months on-site service	1 year; 4 months on-site service	1 year; 4 months on-site service	1 year	1 year	1 year	1 year
FCC certification class	B	B	B	A	A	B	B

PC—Editor's Choice ●—Yes ○—No N/A*— Not applicable: the machine is not available in this configuration.
N/A**—Not applicable: RAM is located on memory cards rather than on the motherboard.

Amax Engineering Corp.			Amdek Corp.	American Mitac Corp.		Arche Technologies Inc.	AST Research Inc.	AT&T	Bus Computer Systems
Amax PC/386-16	Amax PC/386-20	Amax PC/386-25	Amdek System/386e	Mitac Peregon 386C	Mitac Paragon 386E	Arche Rival 386	AST Premium/386C	AT&T 6366 WGS	Bus 386/16
$1,935	$2,585	$4,460	$3,499	$2,775	$4,050	$3,895	$4,395	$3,495	$1,799
1MB RAM, 1.2MB floppy disk drive; two serial, one parallel, and one game port	1MB RAM, 1.2MB floppy disk drive, two serial, one parallel, and one game port	1MB RAM, 1.2MB floppy disk drive; two serial, one parallel, and one game port	1MB RAM, 1.2MB floppy disk drive, two serial and one parallel port, DOS 3.3	1MB RAM, 1.2MB and 1.44MB floppy disk drives, two serial and one parallel port, DOS 3.3	1MB RAM, 1.2MB and 1.44MB floppy disk drives, two serial and one parallel port, DOS 3.3	2MB RAM, 1.2MB floppy disk drive, monochrome monitor, two serial and two parallel ports, DOS 3.3	1MB RAM, 1.2MB floppy disk drive, two serial and one parallel port	1MB RAM, 1.2MB floppy disk drive, one serial and one parallel port	1MB RAM, 1.2MB floppy disk drive, one serial and one parallel port
5 half-height	5 half-height	5 half-height	5 half-height	2 half- and 2 one-third-height	2 half- and 2 one-third-height	3 half-height	5 half-height	4 half-height	7 half-height
$85 (DOS 4.01)/ Unavailable	$85 (DOS 4.01)/ Unavailable	$85 (DOS 4.01)/ Unavailable	Included/$325	Included/ Unavailable	Included/ Unavailable	Included/ Unavailable	$95/$325	$120/$325	$79/Unavailable
3	3	3	1	2	2	8	4	2	10
Two 8-bit, five 16-bit, one 32-bit	Two 8-bit, five 16-bit, one 32-bit	Two 8-bit, five 16-bit, one 32-bit	Three 8-bit, five 16-bit	One 8-bit, four 16-bit	One 8-bit, four 16-bit	Two 8-bit, four 16-bit, two 32-bit	Two 8-bit, four 16-bit, one 32-bit	Two 8-bit, two 16-bit, three 32-bit	One 8-bit, six 16-bit, one 32-bit
4	4	4	6	3	3	4	5	4	4
200	200	200	220	145	145	200	220	200	220
Front	Front	Front	None	Front	Front	Front	Front	Front	Front
80	80	80	120	120	120	72	72	48	90
$2,675 (40MB disk)	$3,250 (40MB disk)	$5,035 (40MB disk)	$4,557 (43MB disk)	$3,664 (40MB disk)	$4,504 (40MB disk)	$4,800 (2MB RAM, 66MB disk)	$6,085 (40MB disk)	$5,290 (40MB disk)	$2,850
$3,275 (40MB disk)	$3,850 (40MB disk)	$5,635 (40MB disk)	$4,989 (43MB disk)	$4,373 (40MB disk)	$5,213 (40MB disk)	N/A*	$6,789 (40MB disk)	$5,313 40MB disk)	$3,350
$4,046	$5,463	$8,238	$6,034	$5,638	$6,393	$5,569	$6,995	$9,607	$4,699
2MB RAM, 80MB hard disk, 1.2MB floppy disk drive, VGA monitor	2MB RAM, 150MB hard disk, 1.2MB floppy disk drive, VGA monitor	4MB RAM, 150MB hard disk, 1.2MB floppy disk drive, VGA monitor	2MB RAM, 43MB hard disk, 1.2MB floppy disk drives, VGA monitor	2MB RAM, 100MB hard disk, 1.2MB and 1.44MB floppy disk drives, VGA monitor	2MB RAM, 100MB hard disk, 1.2MB and 1.44MB floppy disk drives, VGA monitor	2MB RAM, 66MB hard disk, 1.2MB and 1.44MB floppy disk drives, EGA monitor	2MB RAM, 90MB hard disk, 1.2MB floppy disk drive, VGA monitor	4MB RAM, 80MB hard disk, 1.2MB floppy disk drive, VGA monitor	2MB RAM, 70MB hard disk, 1.2MB and 1.44MB floppy disk drives, VGA monitor, 80387 coprocessor
6/18/16 MHz	6/8/20 MHz	6.3/12.5/25 MHz	8/16 MHz	16 MHz	20 MHz	10/20 MHz	4.77/8/20 MHz	6/8/20 MHz	8/16 MHz
8 MHz	10 MHz	8.3/12.5 MHz	8 MHz	8/10 MHz	8/10 MHz	10 MHz	8 MHz	10 MHz	8/10 MHz
0	0	0	0, 1	0, 1	0, 1	0, 1	0	1	0, 1
NCL (ST-506/ MFM)	NCL (ST-506/ MFM)	NCL (ST-506/ MFM)	Western Digital (ST-506/MFM)	American Mitac (ST-506/RLL)	American Mitac (ST-506/RLL)	Adaptec (ST-506/RLL)	Western Digital (ESDI)	Western Digital (ESDI)	Distributed Processing Technology (ST-506/MFM)
4	4	4	4	4	4	3	5	4	5
Phoenix BIOS Plus, Version 1.10 B2	Phoenix BIOS Plus, Version 1.10 B2	Phoenix BIOS Plus, Version 1.10 03a (1988)	Phoenix BIOS, Version 3.53 (July 1985)	Phoenix BIOS Plus, Version 1.10 R21 (January 1989)	Phoenix BIOS, Version 3.07 (R20) (November 1988)	Phoenix BIOS Plus, Version 1.10 02 (January 1988)	AST BIOS, Version 2.0	Olivetti BIOS, Version 1.14	AMI BIOS (September 1988)
Amax	Amax	Micronics	Wyse	American Mitac	American Mitac	Arche	AST	Olivetti	AMI
Intel	Intel	Intel	Intel	Chips and Technologies	Chips and Technologies	Chips and Technologies	Intel	Olivetti	Chips and Technologies
256Kb	256Kb	256Kb	256Kb	256Kb, 1Mb	256Kb, 1Mb	256Kb	256Kb, 1Mb	1Mb	256Kb
DIP	DIP	DIP	DIP	SIMM	SIMM	DIP	SIMM	SIMM	DIP
DRAM	DRAM	DRAM	DRAM	DRAM	DRAM	DRAM	DRAM	DRAM	DRAM
●	●	●	●	●	●	●	○	●	○
BIOS and Video	BIOS and Video	BIOS and Video	None	BIOS and Video	BIOS and Video	BIOS and Video	BIOS and Video	BIOS and Video	None
None	Austek 38125 (32KB)	Intel 82385 (32KB)	None	None	None	None	AST (64K)	None	Bus (64K)
○	○	○	○	○	○	○	●	○	○
N/A**	N/A**	N/A**	N/A**	8MB	8MB	N/A**	N/A**	N/A**	N/A**
16MB	16MB	16MB	6MB	8MB	8MB	16MB	16MB	48MB	16MB
16MB	16MB	16MB	16MB	24MB	24MB	16MB	16MB	48MB	64MB
1 year	1 year	1 year	1 year	1 year	1 year	2 years	1 year	1 year	2 years
B	B	A	B	B	B	A	B	B	B

386-based PCs: Summary of Features

	Bus Computer Systems		Canon USA Inc.	Compaq Computer Corp.		CompuAdd Corp.	
BASIC CONFIGURATION	Bus 386/20	Bus 386/25	Canon A-200SX	Compaq Desk-pro 386/20e	Compaq Desk-pro 386/25	CompuAdd 386/16	CompuAdd 386/20
List price	$2,099	$3,650	$5,500	$5,199	$8,299	$1,895	$2,295
Basic configuration	1MB RAM, 12MB floppy disk drive, one serial and one parallel port	1MB RAM, 12MB floppy disk drive, one serial and one parallel port	1MB RAM, 40MB hard disk, 1.2MB floppy disk drive, two serial and one parallel port, DOS 3.3	1MB RAM, 1.2MB floppy disk drive, one serial, one parallel, and one mouse port	1MB RAM, 60MB hard disk, 1.2MB floppy disk drive, one serial and one parallel port	1MB RAM, 1.2MB floppy disk drive, two serial and one parallel port	1MB RAM, 1.2MB floppy disk drive, two serial and one parallel port
Drive bays	7 half-height	7 half-height	5 half-height	4 half-height	4 half-height	5 half-height	5 half-height
Cost of DOS 3.3/ OS/2 (if available)	$79/ Unavailable	$79/ Unavailable	Included/ Unavailable	$120/$325	$120/$325	$79/ Unavailable	$79/ Unavailable
Hard disk options	10	10	1	4	5	7	7
Slots	One 8-bit, six 16-bit, one 32-bit	One 8-bit, six 16-bit, one 32-bit	Two 8-bit, five 16-bit, one 32-bit	Four 16-bit, one 32-bit	Two 8-bit, five 16-bit, one 32-bit	Two 8-bit, five 16-bit, one 32-bit	One 8-bit, six 16-bit, one 32-bit
Slots free with hard and floppy drives, video, two serial and one parallel port installed	4	5	5	4	6	4	5
Power supply (watts)	220	250	200	175	220	220	230
Reset switch	Front	Front	Front	None	None	None	None
Keyboard cable length (inches)	90	90	96	54	72	72	72
STANDARD CONFIGURATION							
Price of monochrome system with 1MB RAM, 60MB hard disk, DOS	$2,950	$4,325	N/A*	$6,974 (40MB disk)	$8,674 (60MB disk)	$2,731 (70MB disk)	$3,082 (70MB disk)
Price of VGA system	$3,450	$4,825	$6,480 (40MB disk, EGA)	$7,418 (40MB disk)	$9,717 (60MB disk)	$3,406 (70MB disk)	$4,315 (70MB disk)
TESTED CONFIGURATION							
List price with DOS	$4,999	$8,999	$6,480	$11,191	$21,614	$3,917	$4,858
Tested configuration includes	2MB RAM, 100MB hard disk, 1.2MB and 1.44MB floppy disk drives, VGA monitor, 80387 coprocessor	4MB RAM, 330MB hard disk, 1.2MB and 1.44MB floppy disk drives, VGA monitor, 80387 coprocessor	1MB RAM, 40MB hard disk, 1.2MB floppy disk drive, EGA monitor	2MB RAM, 110MB hard disk, 40MB tape backup, 1.2MB and 1.44MB floppy disk drives, VGA monitor, 80387-20 coprocessor	5MB RAM, 300MB hard disk, 135MB tape backup, 1.2MB floppy disk drive, VGA monitor, 80387-25 co-processor	2MB RAM, 70MB hard disk, 1.2MB floppy disk drive, VGA monitor	2MB RAM, 110MB hard disk, 1.2MB floppy disk drive, VGA monitor
Microprocessor clock speeds	8/20 MHz	8/25 MHz	8/16 MHz	20 MHz	4.77/6/8/25 MHz	4.7/6/8/16 MHz	8/20 MHz
Bus clock speeds	8/10 MHz	8/8.33 MHz	8 MHz	8 MHz	8.33 MHz	8 MHz	6.6/10 MHz
Wait states	0, 1	0, 1	0, 1	0	0	0	0
Disk controller manufacturer and type (interface/encoding)	Distributed Processing Technology (ST-506/MFM)	Distributed Processing Technology (ST-506/MFM)	Western Digital (ST-506/MFM)	Compaq (ST-506/MFM)	Compaq (ESDI)	Western Digital (ST-506/MFM)	Adaptec (ST-506/RLL)
Number of drives handled by controller	5	5	4	4	4	4	4
BIOS version and date	AMI BIOS (September 1988)	AMI BIOS (September 1988)	Award 386 BIOS, Version 2.02 (December 1988)	Compaq BIOS (June 1988)	Compaq BIOS (June 1988)	Award BIOS, Version 3.03 (November 1988)	Award BIOS, Version 3.04 (January 1989)
System board manufacturer	AMI	AMI	Acer	Compaq	Compaq	Micronics	CompuAdd
386 chip set manufacturer	Chips and Technologies	Chips and Technologies	Intel	Intel	Intel	None (uses discrete logic)	Chips and Technologies
MEMORY SPECIFICATIONS							
Memory chip type	256Kb	1Mb	1Mb	256Kb	1Mb	256Kb	256Kb, 1Mb
Chip packaging	DIP	SIMM	DIP	DIP	DIP	DIP	SIMM
RAM chips	DRAM	Static column RAM	DRAM	DRAM	DRAM	DRAM	DRAM
Interleaved memory	○	●	○	●	●	○	○
Shadow RAM	BIOS and video	BIOS and video	BIOS and video	None	None	BIOS and video	BIOS and video
Type of cache controller	Bus (64K)	Bus (64K)	None	Intel 82385 (32KB)	Intel 82385 (32KB)	None	Austek (32K)
Disk cache software	○	○	○	●	●	○	○
Maximum RAM on motherboard	N/A**	8MB	4MB	4MB	13MB	N/A**	N/A**
Maximum 32-bit RAM	16MB	24MB	16MB	16MB	16MB	10MB	16MB
Maximum total system RAM	64MB	96MB	16MB	16MB	16MB	16MB	16MB
OTHER							
Warranty	2 years	2 years	1 year	1 year	1 year	1 year	1 year
FCC certification class	B	B	B	B	B	B	B

—Editor's Choice ●—Yes ○—No N/A* —Not applicable: the machine is not available in this configuration.
N/A**—Not applicable: RAM is located on memory cards rather than on the motherboard

	Computer Products United Inc.		Computer Systems Corp.	Continental Technology Inc.		Cordata Technologies Inc.		Core International	
CompuAdd 386/25	CPU 386/20	CPU 386/25	Leo 386/16	Top Gee 386/20	Top Gee 386/25	Cordata CS 5000	Cordata CS 5000-2	Core ATomizer 386/20	Core ATomizer 386/25
$2,895	$1,895	$2,295	$2,499	$1,750	$1,900	$3,195	$3,995	$2,995	$6,495
1MB RAM, 1.2MB floppy disk drive, two serial and one parallel port	1MB RAM, 1.2MB floppy disk drive, two serial and one parallel port	1MB RAM, 1.2MB floppy disk drive, two serial and one parallel port	2MB RAM, 1.2MB floppy disk drive, two serial and one parallel port	1MB RAM, 1.2MB floppy disk drive, two serial and one parallel port	1MB RAM, 1.2MB floppy disk drive, two serial and one parallel port	1MB RAM, 1.2MB floppy disk drive, two serial and one parallel port, DOS. 3.3	1MB RAM, 1.2MB floppy disk drive, two serial and one parallel port, DOS.3.3	1MB RAM, 1.2MB floppy disk drive, two serial and one parallel port	1MB RAM, 1.2MB floppy disk drive, two serial and one parallel port
5 half-height	4 half-height	5 half-height	5 half-height	5 half-height	5 half-height	4 half-height	4 half-height	3 half-height	10 half-height
$79/Unavailable	$85/Unavailable	$85/Unavailable	$99/Unavailable	$49/$300	$49/$300	Included/ Unavailable	Included/ Unavailable	$85/$280	$85/$280
7	8	8	6	7	7	2	2	34	34
One 8-bit, six 16-bit, one 32-bit	One 8-bit, six 16-bit, one 32-bit	One 8-bit, six 16-bit, one 32-bit	Eight 16-bit	Three 8-bit, four 16-bit, one 32-bit	Three 6-bit, four 16-bit, one 32-bit	One 6-bit, five 16-bit	One 8-bit, five 16-bit	One 8-bit, six 16-bit, one 32-bit	One 8-bit, six 16-bit, one 32-bit
5	4	5	8	5	5	5	5	5	5
230	200	200	220	230	230	200	200	200	250
None	Front	Front	Front	Front	Front	Front	Front	Front	Front
72	40	40	84	72	72	144	144	72	72
$3,682 (70MB disk)	$2,720	$3,120	$3,565 (2MB RAM, 80MB disk)	$2,350	$2,650	N/A*	N/A*	$4,200 (70MB disk, VGA monochrome)	$8,093 (70MB disk, VGA monochrome)
$4,637 (70MB disk)	$3,290	$3,695	$4,125 (2MB RAM, 80MB disk)	$2,889	$3,199	$5,734 (2MB RAM, 40MB disk)	$6,534 (2MB RAM, 40MB disk)	$4,383 (70MB disk)	$8,276 (70MB disk)
$8,290	$4,575	$7,030	$3,825	$3,314	$7,253	$5,734	$7,034	$5,872	$15,000
4MB RAM, 320MB hard disk, 1.2MB floppy disk drive, VGA monitor	2MB RAM, 70MB hard disk, 1.2MB floppy disk drive, VGA monitor, 80387-20 coprocessor	4MB RAM, 230MB hard disk, 1.2MB floppy disk drive, VGA monitor, 80387-20 coprocessor	2MB RAM, 40MB hard disk, 1.2MB floppy disk drive, VGA monitor	2MB RAM, 60MB hard disk, 1.2MB floppy disk drive, VGA monitor	8MB RAM, 120MB hard disk, 1.2MB floppy disk drive, VGA monitor	2MB RAM, 40MB hard disk, 1.2MB floppy disk drive, VGA monitor	2MB RAM, 80MB hard disk, 1.2MB floppy disk drive, VGA monitor	1MB RAM, 90MB hard disk, 1.2MB floppy disk drive, VGA monitor, 80387 coprocessor	4MB RAM, 650MB hard disk, 1.2MB floppy disk drive, VGA monitor
8/25 MHz	8/20 MHz	8/25 MHz	6/16 MHz	8/20 MHz	8/25 MHz	6/16 MHz	8/20 MHz	8/20 MHz	8/25 MHz
8.33/12.5 MHz	8 MHz	8 MHz	8 MHz	8 MHz	8 MHz	8 MHz	8 MHz	8/10 MHz	8/10 MHz
0	0, 1	0, 1	0	0, 1	0, 1	0, 1	0, 1	0, 1	0, 1
Adaptec (ESDI)	Adaptec (ST-506/RLL)	Adaptec (ST-506/RLL)	Data Technology Corp (ST-506/ MFM)	Data Technology Corp. (ST-506/ RLL)	Data Technology Corp. (ST-506/ RLL)	Cordata (ST-506/MFM)	Cordata (ST-506/MFM)	Core (ESDI)	Core (ESDI)
4	4	5	5	4	4	4	4	4	4
Award BIOS, Version 3.04 (January 1989)	AMI BIOS (December 1988)	AMI BIOS (December 1988)	Phoenix BIOS (January 1988)	Phoenix BIOS, Version 1.1002 (January 1988)	Phoenix BIOS, Version 1.1002 (January 1988)	Cordata BIOS Plus, Version 1.10 09 (May 1988)	Cordata BIOS Plus, Version 1.10 09 (May 1988)	AMI BIOS (September 1988)	AMI BIOS (September 1988)
CompuAdd	AMI	AMI	First International	CTX	CTX	Cordata	Cordata	Core	Core
Chips and Technologies	Chips and Technologies	Chips and Technologies	Olivetti	Chips and Technologies	Chips and Technologies	Chips and Technologies	Chips and Technologies	Chips and Technologies	Chips and Technologies
256Kb, 1Mb SIMM	256Kb, 1Mb DIP,	256Kb, 1Mb DIP, SIMM	256Kb DIP	256Kb SIP	1Mb SIP	256Kb, 1Mb SIMM	256Kb, 1Mb SIMM	256Kb SIMM	256Kb DIP
DRAM	DRAM	DRAM	DRAM	DRAM, static column RAM	DRAM, static column RAM	DRAM	DRAM	Static column RAM	DRAM
○	○	○	○	●	●	●	●	○	○
BIOS and video	BIOS and video	BIOS and video	BIOS	BIOS and video	BIOS and video	BIOS and video	BIOS and video	BIOS and video	BIOS and video
Austek (32K)	AMI (64K)	AMI (64K)	None	None	None	None	None	Core (64K)	Core (64K)
○	○	○	○	○	○	●	●	●	●
N/A**	N/A**	8MB	N/A**	8MB	8MB	16MB	16MB	8MB	8MB
16MB	16MB	16MB	18MB	16MB	16MB	18MB	16MB	18MB	16MB
16MB	16MB	16MB	16MB	16MB	16MB	16MB	16MB	16MB	16MB
1 year	1 year	1 year	1 year	1 year	1 year	1 year	1 year	1 year	1 year
B	A	A	A	B	B	A	A	B	B

386-based PCs: Summary of Features

	DataWorld Inc.			Dell Computer Corp.		Destiny Computers	
BASIC CONFIGURATION	DataWorld Data 386-16	DataWorld Data 386-20	DataWorld Data 386-25	Dell System 310	Dell System 325	Destiny 386-16	Destiny 386-20
List price	$1,995	$2,695	$3,695	$2,799	$4,599	$2,306	$2,500
Basic configuration includes	1MB RAM, 1.2MB floppy disk drive, monochrome monitor, one parallel port	1MB RAM, 1.2MB floppy disk drive, monochrome monitor, one parallel port	1MB RAM, 1.2MB floppy disk drive, monochrome monitor, one parallel port	1MB RAM, 1.2MB floppy disk drive, two serial and one parallel port	1MB RAM 1.2MB floppy disk drive, two serial and one parallel port	1MB RAM, 1.2MB floppy disk drive	1MB RAM, 1.2MB floppy disk drive
Drive bays	5 half-height	5 half-height	6 half-height	5 half-height	5 half-height	5 half-height	5 half-height
Cost of DOS 3.3/ OS/2 (if available)	$75/$315	$75/$315	$75/$315	$100/$325	$100/$325	$110/Unavailable	$110/Unavailable
Hard disk options	12	12	12	4	3	16	16
Slots	Two 8-bit, five 16-bit, one 32-bit	One 8-bit, six 16-bit, one 32-bit	Two 8-bit, six 16-bit, one 32-bit	Two 8-bit, six 16-bit, one 32-bit	Two 8-bit, six 16-bit, one 32-bit	Two 8-bit, five 16-bit, one 32-bit	Two 8-bit, five 16-bit, one 32-bit
Slots free with hard and floppy drives, video, two serial and one parallel port installed	4	4	5	6	6	4	4
Power supply (watts)	230	200	230	230	230	200	200
Reset switch	Front	Front	Front	None	None	Front	Front
Keyboard cable length (inches)	72	72	72	72	72	108	108
STANDARD CONFIGURATION							
Price of monochrome system with 1MB RAM, 60MB hard disk, DOS	$2,593 (66MB disk)	$3,393 (66MB disk)	$4,293 (66MB disk)	$3,799 (40MB disk)	$6,100 (90MB disk)	$2,800	$3,271
Price of VGA system	$3,193 (66MB disk)	$3,893 (66MB disk)	$4,893 (66MB disk)	$4,299 (40MB disk)	$6,400 (90MB disk)	$3,300	$3,780
TESTED CONFIGURATION							
List price	$3,553	$4,393	$7,594	$6,229	$9,130	$5,225	$5,870
Tested configuration includes	2MB RAM, 44MB hard disk, 1.2MB floppy disk drive, VGA monitor	2MB RAM, 66MB hard disk, 1.2MB floppy disk drive, VGA monitor	4MB RAM, 150MB hard disk, 1.2MB floppy disk drive, VGA monitor	4MB RAM, 90MB hard disk, 1.2MB and 1.44MB floppy disk drives, VGA monitor	4MB RAM, 322MB hard disk, 1.2MB and 1.44MB floppy disk drives, VGA monitor	4MB RAM, 106MB hard disk, 1.2MB floppy disk drive, CGA monitor	4MB RAM, 106MB hard disk, 1.2MB floppy disk drive, VGA monitor
Microprocessor clock speeds	6/8/16 MHz	8/20 MHz	8/25 MHz	4.77/8.20 MHz	4.77/8/25 MHz	6/8/16 MHz	6/8/20 MHz
Bus clock speeds	8 MHz	10 MHz	8.33 MHz	8 MHz	8 MHz	8 MHz	10 MHz
Wait states	0	0, 1	0, 1	0	0	0, 1	0, 1
Disk controller manufacturer and type (interface/encoding)	Data Technology Corp (ST-506/ MFM)	Data Technology Corp (ST-506/ RLL)	Data Technology Corp (ESDI)	Western Digital (ESDI)	Western Digital (ESDI)	Adaptek (ESDI)	Adaptek (ESDI)
Number of drives handled by controller	4	4	4	4	4	4	4
BIOS version and date	Phoenix BIOS Plus, Version 1.10.03 (January 1988)	AMI BIOS II (September 1988)	AMI BIOS II (September 1988)	Phoenix BIOS Plus, Version 1.10.09 (January 1988)	Phoenix BIOS Plus, Version 1.10 X48 (January 1988)	Award BIOS, Version C3.03	Phoenix BIOS, Version 1.1003 (January 1988)
System board manufacturer	Micronics	AMI	AMI	Dell	Dell	Micronics	Micronics
386 chip set manufacturer	Chips and Technologies	Chips and Technologies	Chips and Technologies	Chips and Technologies	Chips and Technologies	None (uses discrete logic)	Chips and Technologies
MEMORY SPECIFICATIONS							
Memory chip type	256Kb	256Kb, 1Mb	256Kb, 1Mb	256Kb, 1Mb	256Kb, 1Mb	256Kb, 1Mb	1Mb
Chip packaging	DIP	DIP	DIP, SIMM	SIMM	SIMM	DIP	DIP
RAM chips	DRAM	DRAM	DRAM	DRAM, static column RAM	DRAM, static column RAM	DRAM	DRAM
Interleaved memory	○	○	○	●	●	○	○
Shadow RAM	BIOS and video	Video	BIOS and video	BIOS and video	BIOS and video	BIOS and video	BIOS and video
Type of cache controller	None	AMI (64K)	AMI (64K)	Intel 82385 (32K)	Intel 82385 (32K)	None	Austek (32K)
Disk cache software	●	●	●	●	●	○	○
Maximum RAM on motherboard	8MB	N/A**	8MB	8MB	8MB	N/A**	N/A**
Maximum 32-bit RAM	16MB	16MB	16MB	8MB	8MB	16MB	16MB
Maximum total system RAM	16MB	16MB	16MB	8MB	8MB	16MB	16MB
OTHER							
Warranty	1 year	1 year for CPU, 6 months for parts	1 year	1 year	1 year	1 year	1 year
FCC certification class	A	A	A	A	A	B	B

—Editor's Choice ●—Yes ○—No N/A* —Not applicable: the machine is not available in this configuration.
N/A**—Not applicable: RAM is located on memory cards rather than on the motherboard

	Everest Computer Corp.	Everex Computer Systems			FiveStar Computers	Fortree Corp.			Fountain Technologies Inc.
Destiny 386-25	Everest Block 320	Everex Step 386/16	Everex Step 386/20	Everex Step 386/25	FiveStar Model 320	Fortree 386 16	Fortree 386 20 Plus	Fortron 386 25	Fountain 385/20
$2,900	$1,995	$3,699	$4,199	$4,999	$2,049	$2,400	$2,900	$3,900	$2,170
1MB RAM, 1.2MB floppy disk drive	1MB RAM, 1.2MB floppy disk drive, two serial and two parallel ports	1MB RAM, 1.2MB floppy disk drive, one serial and one parallel port, DOS 3.3	1MB RAM, 1.2MB floppy disk drive, one serial and one parallel port, DOS 3.3	1MB RAM, 1.2MB floppy disk drive, one serial and one parallel port, DOS 3.3	1MB RAM, 1.2MB floppy disk drive; one serial, one parallel, and one game port	2MB RAM, 1.2MB floppy disk drive, two serial and one parallel port	1MB RAM, 1.2MB floppy disk drive, one serial and one parallel port	1MB RAM, 1.2MB floppy disk drive, one serial and one parallel port	1MB RAM, 1.2MB floppy disk drive; one serial, one parallel, and one game port
5 half-height	4 half-height	5 half-height	5 half-height	5 half-height	5 half-height	5 half-height	5 half-height	5 half-height	5 half-height
$110/Unavailable	$95/Unavailable	Included/$325	Included/$325	Included/$325	$100/Unavailable	$90/$399	$90/$399	$90/$399	$70/$350
16	6	4	4	4	7	6	6	6	5
Two 8-bit, five 16-bit, one 32-bit	Four 8-bit, four 16-bit, one 32-bit	One 8-bit, six 16-bit, one 32-bit	One 8-bit, six 16-bit, one 32-bit	One 8-bit, six 16-bit, one 32-bit	One 8-bit, six 16-bit, one 32-bit	Two 8-bit, four 16-bit, two 32-bit	One 8-bit, six 16-bit, one 32-bit	One 8-bit, six 16-bit, one 32-bit	Two 8-bit, five 16-bit, one 32-bit
4	5	5	5	5	5	5	5	5	4
200	200	200	200	200	230	230	230	230	200
Front	Front	Front	Front	Front	Front	Front	Front	Front	Front
108	102	120	120	120	110	90	90	90	102
$3,846	$2,899	$4,597 (40MB disk)	$5,097 (40MB disk)	$7,045 (40MB disk)	$2,965 (80MB disk)	$3,400 (2MB RAM)	$3,900	$4,900	$3,390
$4,350	$3,608	$5,147 (40MB disk, EGA)	$5,866 (40MB disk, EGA)	$7,427 (40MB disk, EGA)	$3,664 (80MB disk)	$3,700 (2MB RAM)	$4,200	$5,200	$4,150
$7,000	$3,995	$5,377	$10,547	$12,047	$4,300	$3,465	$5,300	$7,900	$5,190
4MB RAM, 182MB hard disk, 1.2MB floppy disk drive, VGA monitor	2MB RAM, 60MB hard disk, 1.2MB floppy disk drive, VGA monitor	1MB RAM, 80MB hard disk, 1.2MB floppy disk drive, EGA monitor	4MB RAM, 330MB hard disk, 1.2MB floppy disk drive, EGA monitor	4MB RAM, 330MB hard disk, 1.2MB floppy disk drive, EGA monitor	2MB RAM, 80MB hard disk, 1.2MB and 1.44MB floppy disk drives, VGA monitor	2MB RAM, 40MB hard disk, 1.2MB floppy disk drive, VGA monitor	2MB RAM, 80MB hard disk, 1.2MB floppy disk drive, VGA monitor, 80387-20 coprocessor	4MB RAM, 141MB hard disk, 1.2MB floppy disk drive, VGA monitor, tower case	2MB RAM, 150MB hard disk, 1.2MB and 1.44MB floppy disk drives, VGA monitor
6/8/25 MHz	6/20 MHz	5/8/16 MHz	6.7/10/20 MHz	8/12.5/25 MHz	6/20 MHz	8/16 MHz	10/20 MHz	8/25 MHz	6/8/20 MHz
8/12 MHz	10 MHz	5.3/8 MHz	8/10 MHz	8/12.5 MHz	8/10 MHz	8 MHz	10 MHz	6.33 MHz	10 MHz
0, 1	0, 1	0	0	0	0	0, 1	0, 1	0, 1	0
Adaptek (ESDI)	Data Technology Corp. (ST-506/MFM)	Scientific Micro Systems (ST-506/MFM)	Western Digital (ESDI)	Western Digital (ESDI)	Western Digital (ST-506/MFM)	Western Digital (ST-506/MFM)	Western Digital (ST-506/MFM)	Western Digital (ESDI)	Omti (ESDI)
4	3	4	4	4	4	4	4	4	4
Phoenix BIOS, Version 1.1003 (January 1988)	AMI BIOS (January 1987)	AMI BIOS (July 1988)	AMI BIOS (July 1988)	AMI BIOS (July 1988)	AMI BIOS (September 1988)	Phoenix BIOS Plus, Version 1.1 (June 1988)	AMI BIOS (September 1988)	AMI BIOS (June 1988)	Phoenix BIOS Plus, Version 1.10.03a (January 1988)
Micronics	CMP Everest	Everex	Everex	Everex	Mylex	Fortron	AMI	AMI	Micronics
Chips and Technologies	Chips and Technologies	None (uses discrete logic)	None (uses discrete logic)	None (uses discrete logic)	None (uses discrete logic)	Intel	Intel	Intel	None (uses discrete logic)
256Kb, 1Mb	256Kb, 1Mb	256Kb, 1Mb	256Kb, 1Mb	256Kb, 1Mb	256Kb, 1Mb	256Kb	256Kb	1Mb	256Kb, 1Mb
DIP	DIP, SIP	DIP, SIMM	DIP, SIMM	DIP, SIMM	SIMM	DIP	DIP	SIMM	DIP
DRAM	DRAM	DRAM	DRAM	DRAM	DRAM	DRAM	DRAM	DRAM	DRAM, static column RAM
○	●	○	○	○	●	●	●	●	○
BIOS and video	BIOS	BIOS	BIOS	BIOS	○	○	BIOS and video	BIOS and video	BIOS and video
Intel 82385 (32K)	None	AMMA (64K)	AMMA (64K)	AMMA (64K)	FiveStar (64K)	None	AMI (64K)	AMI (64K)	Intel 82385 (32K)
○	○	●	●	●	○	●	●	●	○
N/A**	8MB	8MB	8MB	8MB	8MB	N/A**	N/A**	8MB	N/A**
16MB	8MB	16MB	16MB	16MB	16MB	16MB	16MB	24MB	10MB
16MB	8MB	32MB	32MB	32MB	15MB	16MB	18MB	24MB	16MB
1 year	1 year	1 year	1 year	1 year	1 year on-site service	1 year on-site service	1 year on-site service	1 year on-site service	1 year
B	A	B	B	B	A	B	A	A	A

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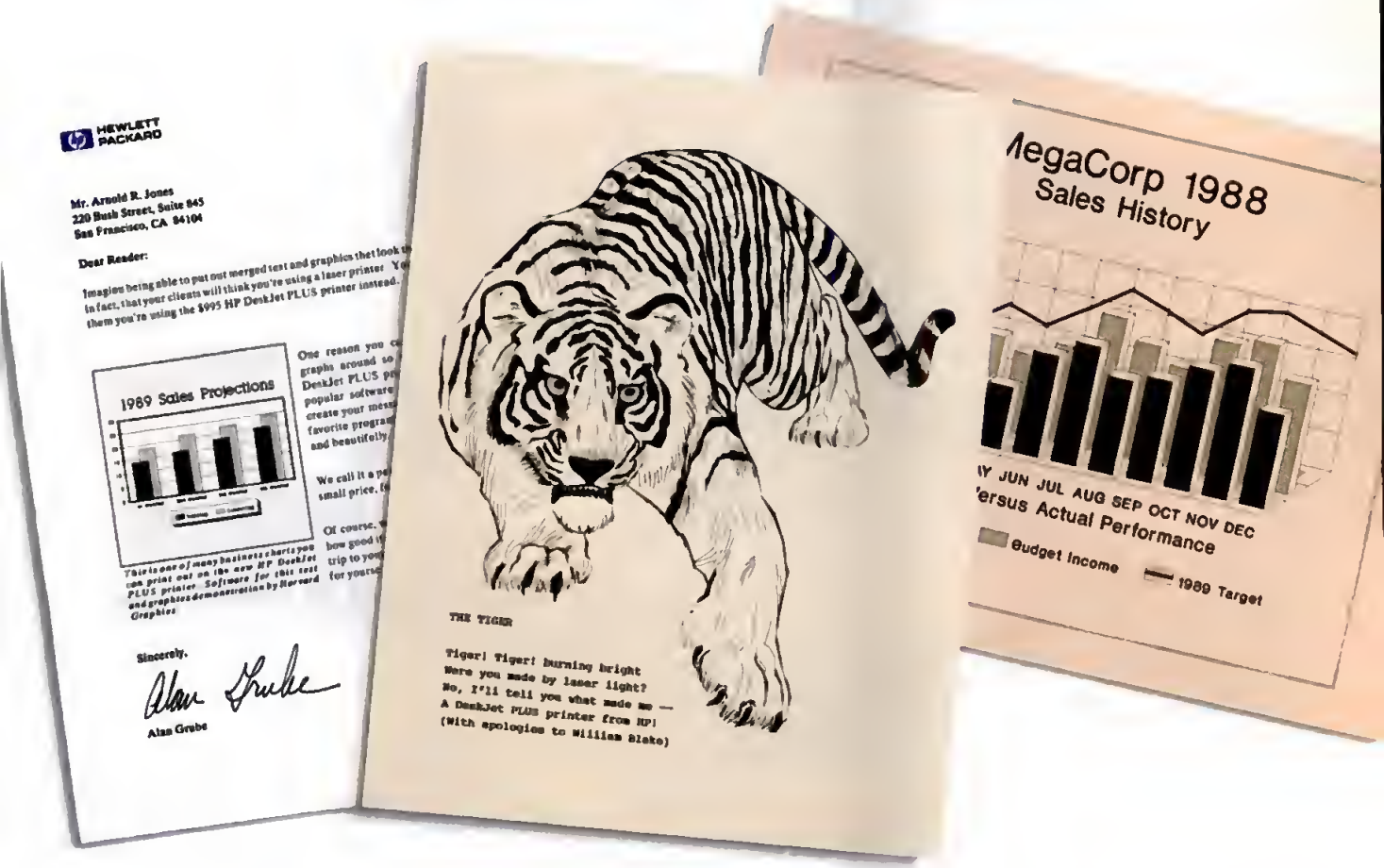

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CIRCLE 491 ON READER SERVICE CARD

386-based PCs: Summary of Features

	Fountain Technologies Inc.	General Technology Corp.	Hartz Computer Corp.		Hewlett-Packard Corp.		
BASIC CONFIGURATION	Fountain 386/25	GenTech 386	Hartz 386/16	Hartz 386/25	HP Vectra QS/16	HP Vectra RS/20	HP Vectra RS/25c
List price	$4,030	$1,799	$2,695	$4,995	$3,995	$7,595	$10,295
Basic configuration includes	1MB RAM, 1.2MB floppy disk drive; one serial, one parallel, and one game port	1MB RAM, 1.2MB floppy disk drive, two serial and two parallel ports	2MB RAM, 1.2MB floppy disk drive, one serial and one parallel port	1MB RAM, 1.2MB floppy disk drive, two serial and one parallel port	1MB RAM, 1.2MB floppy disk drive, one serial and one parallel port	1MB RAM, 103MB hard disk, 1.2MB floppy disk drive, one serial and one parallel port	1MB RAM, 103MB hard disk, 1.2MB floppy disk drive, one serial and one parallel port
Drive bays	5 half-height	5 half-height	5 half-height	5 half-height	3 half-height	8 half-height	6 half-height
Cost of DOS 3.3/ OS/2 (if available)	$70/$350	$89/Unavailable	$99/$325	$99/$325	$120/$325	$120/$325	$120/$325
Hard disk options	5	12	6	8	2	3	3
Slots	Two 8-bit, five 16-bit, one 32-bit	Two 8-bit, five 16-bit, one 32-bit	Two 8-bit, four 16-bit, two 32-bit	One 8-bit, five 16-bit, two 32-bit	One 8-bit, six 16-bit, one 32-bit	Two 8-bit, six 16-bit, one 32 bit	Two 8-bit, six 16-bit, one 32-bit
Slots free with hard and floppy drives, video, two serial and one parallel port installed	4	5	6	6	4	6	6
Power supply (watts)	200	200	220	220	220	230	230
Reset switch	Front	None	None	None	None	None	None
Keyboard cable length (inches)	138	72	72	72	96	96	96
STANDARD CONFIGURATION							
Price of monochrome system with 1MB RAM, 60MB hard disk, DOS	$5,250	$2,425 (40MB disk)	$3,395 (2MB RAM, 40MB disk)	$5,495 (40MB disk)	$5,910 (40MB disk, VGA monochrome)	$8,400 (103MB disk, VGA monochrome)	$11,110 (103MB disk, VGA monochrome)
Price of VGA system	$6,010	$2,850 (40MB disk)	$3,995 (2MB RAM, 40MB disk)	$5,995 (40MB disk)	$6,580 (40MB disk)	$9,060 (103MB disk)	$11,780 (103MB disk)
TESTED CONFIGURATION							
List price	$8,850	$2,850	$4,495	$9,995	$7,230	$9,875	$13,175
Tested configuration includes	4MB RAM, 150MB hard disk, 1.2MB and 1.44 floppy disk drives, VGA monitor	1MB RAM, 40MB hard disk, 1.2MB floppy disk drive, VGA monitor	2MB RAM, 70MB hard disk, 1.2MB and 1.44MB floppy disk drives, VGA monitor	4MB RAM, 330MB hard disk, 1.2MB and 1.44MB floppy disk drives, VGA monitor	2MB RAM, 40MB hard disk, 1.2MB floppy disk drive, VGA monitor	2MB RAM, 103MB hard disk, 1.2MB and 1.44MB floppy disk drives, VGA monitor	4MB RAM, 155MB hard disk, 1.2MB and 1.44MB floppy disk drives, VGA monitor
Microprocessor clock speeds	8/25 MHz	8/10/16/20 MHz	8/16 MHz	8/25 MHz	8/16 MHz	5 5/10/20 MHz	5 5/12/25 MHz
Bus clock speeds	8.33 MHz	8.58 MHz	8 MHz	8 MHz	8 MHz	8/10 MHz	8/12.5 MHz
Wait states	0	0	0, 1	0, 1	0	0	0
Disk controller manufacturer and type (interface/encoding)	Omti (ESDI)	Western Digital (ST-506/MFM)	Western Digital (ST-506/MFM)	Western Digital (ESDI)	Western Digital (ST-506/MFM)	Western Digital (ESDI)	Western Digital (ESDI)
Number of drives handled by controller	4	4	4	4	4	4	4
BIOS version and date	Phoenix BIOS Plus, Version 1.10 03a (January 1988)	Award BIOS (September 1987)	Phoenix BIOS Plus, Version 1.10 (January 1988)	Phoenix BIOS Plus, Version 1.10 (January 1988)	HP BIOS, Version D.02.00 (1988)	HP BIOS, Version E.02.00 (December 1988)	HP BIOS, Version E.02.00 (December 1988)
System board manufacturer	Micronics	CSS Labs	Intel	Intel	Hewlett-Packard	Hewlett-Packard	Hewlett-Packard
386 chip set manufacturer	None (uses discrete logic)	Intel	Intel	Intel	Chips and Technologies	Chips and Technologies	Chips and Technologies
MEMORY SPECIFICATIONS							
Memory chip type	1Mb	1Mb	256Kb, 1Mb	256Kb, 1Mb	256Kb, 1Mb	256Kb, 1Mb	256Kb, 1Mb
Chip packaging	DIP	DIP	DIP, SIMM	DIP, SIMM	SIMM	SIMM	SIMM
RAM chips	DRAM, static column RAM	SRAM	DRAM, SRAM	DRAM, SRAM	DRAM, static column RAM	DRAM, static column RAM	DRAM
Interleaved memory	○	○	●	●	●	●	○
Shadow RAM	BIOS and video	○	BIOS and video	BIOS and video	BIOS and video	BIOS and video	BIOS and video
Type of cache controller	Intel 82385 (32K)	None	None	Intel 82385 (64K)	None	Intel 82385 (32K)	Intel 82385 (32K)
Disk cache software	○	○	●	●	●	●	●
Maximum RAM on motherboard	N/A**	4MB	2MB	8MB	16MB	16MB	16MB
Maximum 32-bit RAM	16MB	12MB	18MB	24MB	16MB	16MB	16MB
Maximum total system RAM	16MB	16MB	18MB	24MB	16MB	16MB	16MB
OTHER							
Warranty	1 year	1 year	1 year	1 year on-site service	1 year	1 year	1 year
FCC certification class	A	A (pending)	B	B	B	B	B

PC—Editor's Choice ●—Yes ○—No N/A*—Not applicable: the machine is not available in this configuration.
N/A**—Not applicable: RAM is located on memory cards rather than on the motherboard

HiTech International Inc. — HiTech SAM 3001/386	IBM Corp. — IBM PS/2 Model 70-E61	IBM PS/2 Model 70-121	IBM PS/2 Model 70-A21	Laser Digital Inc. — Pacer 386 20	Pacer 386 25	Leading Edge Hardware Products Inc. — Leading Edge Model D3	Memorex Telex Corp. — Memorex Telex 386-20	Micro Express Inc. — Micro Express 386-20	Micro Express 386-25
$1,295	$5,995	$7,995	$11,295	$1,961	$3,500	$3,795	$4,595	$2,100	$3,995
1MB RAM, 1.2MB floppy disk drive, two serial and one parallel port	1MB RAM, 60MB hard disk, 1.44MB floppy disk drive, one serial and one parallel port	2MB RAM, 120MB hard disk, 1.44MB floppy disk drive, one serial and one parallel port	2MB RAM, 120MB hard disk, 1.44MB floppy disk drive, one serial and one parallel port	2MB RAM, 1.2MB floppy disk drive, two serial and one parallel port	4MB RAM, 1.2MB floppy disk drive, two serial and one parallel port	1MB RAM, 65MB hard disk, 1.2MB floppy disk drive, two serial and one parallel port, DOS 3.3	2MB RAM, 1.44MB floppy disk drive, two serial and one parallel port, DOS 3.3	1MB RAM, 1.2MB or 1.44MB floppy disk drive, one serial and one parallel port	4MB RAM, 1.2MB or 1.44MB floppy disk drive, one serial and one parallel port
5 half-height	3 half-height	3 half-height	3 half-height	5 half-height	5 half-height	3 half-height	4 half-height	5 half-height	5 half-height
$75/Unavailable	$150 (DOS 4.01)/ $340	$150 (DOS 4.01)/ $340	$150 (DOS 4.01)/ $340	$50/Unavailable	$50/Unavailable	Included/ Unavailable	Included/ Unavailable	$75/$275	$75/$275
4	1	1	1	6	6	0	3	2	2
Two 8-bit, four 16-bit, two 32-bit	One 16-bit, two 32-bit (MCA)	One 16-bit, two 32-bit (MCA)	One 16-bit, two 32-bit (MCA)	One 8-bit, five 16-bit, two 32-bit	One 8-bit, six 16-bit, one 32-bit	Two 8-bit, four 16-bit, four 32-bit	One 8-bit, four 16-bit	One 8-bit, six 16-bit, one 32-bit	One 8-bit, six 16-bit, one 32-bit
4	3	3	3	4	4	4	3	5	5
230	132	132	132	200	200	200	150	200	200
Front	None	None	None	Front	Front	Front	Front	Front	Front
60	98	98	98	120	120	72	72	78	108
$1,895	$5,420	$8,420 (2MB RAM, 120MB disk)	$11,720 (2MB RAM, 120MB disk)	$3,000 (2MB RAM, 60MB disk)	$4,400 (4MB RAM, 60MB disk)	$3,994 (65MB disk, VGA monochrome)	$7,105 (2MB RAM, 60MB disk)	$2,950 (72MB disk)	$4,845 (4MB RAM, 72MB disk)
$2,650	$5,895	$8,895 (2MB RAM, 120MB disk)	$12,195 (2MB RAM, 120MB disk)	$3,972 (2MB RAM, 60MB disk)	$5,149 (4MB RAM, 60MB disk)	$4,483 (65MB disk)	$7,699 (2MB RAM, 60MB disk)	$3,550 (72MB disk)	$5,445 (4MB RAM, 72MB disk)
$2,895	$7,690	$9,540	$12,925	$3,972	$5,495	$5,479	$9,139	$5,350	$6,345
2MB RAM, 43MB hard disk, 1.2MB floppy disk drive, VGA monitor, 80287-10 coprocessor	2MB RAM, 60MB hard disk, 1.44MB floppy disk drive, VGA monitor, DOS 4.01	2MB RAM, 120MB hard disk, 1.44MB floppy disk drive, VGA monitor, 80387-16 coprocessor, DOS 4.01	2MB RAM, 120MB hard disk, 1.44MB floppy disk drive, VGA monitor, 80387-25 coprocessor, DOS 4.01	2MB RAM, 80MB hard disk, 1.2MB floppy disk drive, VGA monitor	4MB RAM, 130MB hard disk, 1.2MB floppy disk drive, VGA monitor	2MB RAM, 65MB hard disk, 1.2MB floppy disk drive, VGA monitor	4MB RAM, 80MB hard disk, 1.2MB and 1.44MB floppy disk drives, VGA monitor	4MB RAM, 150MB hard disk, 1.2MB floppy disk drive, VGA monitor	4MB RAM, 150MB hard disk, 1.2MB floppy disk drive, VGA monitor
6/8/16 MHz	16 MHz	20 MHz	25 MHz	10/20 MHz	8/25 MHz	8/16 MHz	20 MHz	8/20 MHz	8/25 MHz
6 MHz	10 MHz	10 MHz	10 MHz	8/8.33 MHz	8/8.33 MHz	8 MHz	8/10 MHz	8 MHz	8/25 MHz
1	2	0, 2	0	0, 1	0, 1	0	0, 1	0	0
Western Digital (ST-506/MFM)	IBM (ESDI)	IBM (ESDI)	IBM (ESDI)	Western Digital (ST-506/MFM)	Western Digital (ESDI)	Adaptec (ST-506/RLL)	Quantum (ST-506/RLL)	Data Technology Corp. (ESDI)	Data Technology Corp. (ESDI)
4	3	3	3	4	4	3	5	5	5
Award BIOS, Version 3.03 (December 1987)	IBM BIOS (April 1988)	IBM BIOS (April 1988)	IBM BIOS (April 1988)	AMI BIOS (January 1989)	AMI BIOS (June 1986)	Phoenix BIOS (1988)	Phoenix BIOS (1988)	AMI BIOS (September 1988)	AMI BIOS (September 1988)
American Digicom	IBM	IBM	IBM	Laser Digital	AMI	Daewoo	Mitac	AMI	AMI
Intel	Intel	Intel	Intel	Chips and Technologies	None (uses discrete logic)	Chips and Technologies	Chips and Technologies	Chips and Technologies	Chips and Technologies
256Kb	1Mb	1Mb	1Mb	256Kb, 1Mb	256Kb, 1Mb, 4Mb	256Kb	256Kb	1Mb	1Mb
DIP	SIMM	SIMM	SIMM	DIP	DIP, SIMM	SIMM	SIP	DIP	DIP
Static column RAM	DRAM	DRAM	DRAM	DRAM	DRAM, SRAM	DRAM	DRAM	DRAM, SRAM, static column RAM	DRAM, SRAM, static column RAM
○	●	●	○	●	●	●	●	○	○
BIOS	○	○	○	BIOS and video	BIOS and video	BIOS and video	BIOS and video	BIOS and video	BIOS and video
None	None	None	Intel 82365 (64K)	None	Pacer (32K)	None	None	AMI (64K)	AMI (64K)
○	●	●	●	○	○	●	○	●	●
N/A**	6MB	6MB	6MB	4MB	16MB	6MB	6MB	6MB	8MB
16MB	16MB	16MB	16MB	16MB	16MB	8MB	6MB	16MB	16MB
16MB	16MB	16MB	16MB	16MB	16MB	16MB	16MB	16MB	16MB
1 year, 90 days for hard disk	1 year	1 year	1 year	1 year	1 year	20 months	1 year	15 months; 1 year for disk drives	15 months; 1 year for disk drives
B	B	B	B	B	B	B	B	B	B

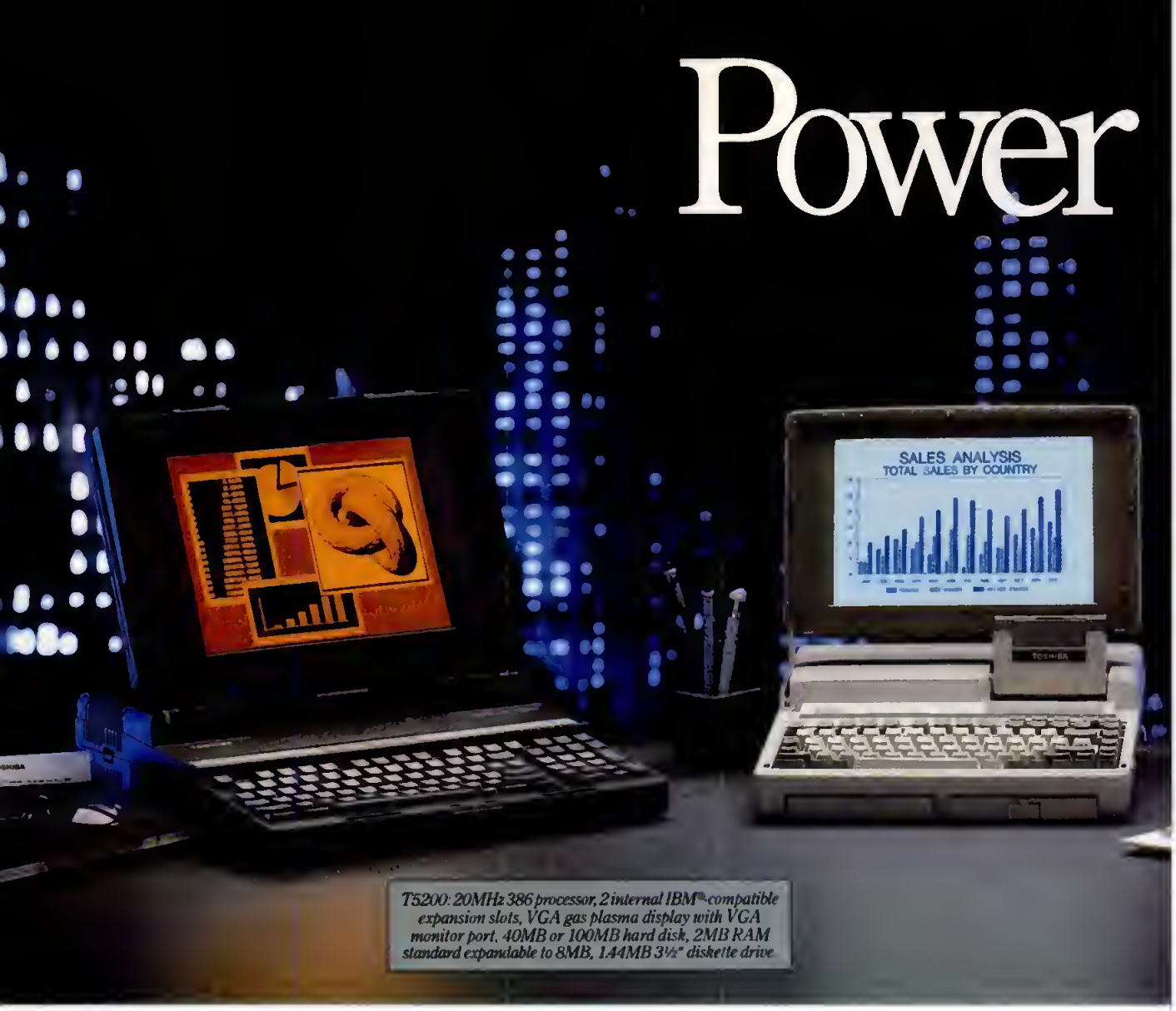
386-based PCs: Summary of Features

	Micro 1 Inc.		Mitsubishi Electronics America Inc.	NCR Corp.	NEC Information Systems Inc.	Northgate Computer Systems	
BASIC CONFIGURATION	Micro 1 Power 386-16	Micro 1 Power 386-20	Mitsubishi MP386	NCR PC616	NEC PowerMate 386/20	Northgate Elegance 386/20	Northgate Elegance 386/25
List price	$1,530	$2,010	$3,995	$4,495	$4,695	$3,399	$3,999
Basic configuration includes	1MB RAM, 1.2MB floppy disk drive; one serial, one parallel, and one game port	1MB RAM, 1.2MB floppy disk drive; one serial, one parallel, and one game port	1MB RAM, 1.2MB floppy disk drive, DOS 3.3	2MB RAM, 1.2MB floppy disk drive	2MB RAM, 1.2MB or 1.44MB floppy disk drive, two serial and one parallel port	1MB RAM, 68MB hard disk, 1.2MB and 1.44MB floppy disk drives, monochrome monitor, two serial and one parallel port, DOS 3.3	1MB RAM, 68MB hard disk, 1.2MB and 1.44MB floppy disk drives, monochrome monitor, two serial and one parallel port, DOS 3.3
Drive bays	5 half-height	5 half-height	5 half-height	5 half-height	5 half-height	5 half-height	5 half-height
Cost of DOS 3.3/ OS/2 (if available)	$95/ Unavailable	$95/ Unavailable	Included/ Unavailable	$120/$325	$65/$325	Included/ Unavailable	Included/ Unavailable
Hard disk options	17	17	2	4	4	7	7
Slots	One 8-bit, six 16-bit, one 32-bit	One 8-bit, six 16-bit, one 32-bit	Two 8-bit, six 16-bit, two 32-bit	Two 8-bit, four 16-bit, two 32-bit	Two 8-bit, five 16-bit, one 32-bit	One 8-bit, six 16-bit, one 32-bit	One 8-bit, six 16-bit, one 32-bit
Slots free with hard and floppy drives, video, two serial and one parallel port installed	4	4	8	5	5	5	5
Power supply (watts)	285	285	240	220	237	200	200
Reset switch	Front	Front	Front	None	Front	Front	Front
Keyboard cable length (inches)	150	150	72	132	120	72	72
STANDARD CONFIGURATION							
Price of monochrome system with 1MB RAM, 60MB hard disk, DOS	$2,095	$2,575	$5,895 (70MB disk)	$6,690 (2MB RAM, 70MB disk)	N/A*	$3,399 (68MB disk)	$3,999 (68MB disk)
Price of VGA system	$2,550	$3,030	$6,795 (70MB disk)	$7,194 (2MB RAM, 70MB disk)	$7,240 (2MB RAM, 42MB disk)	$4,024 (68MB disk)	$4,624 (68MB disk)
TESTED CONFIGURATION							
List price	$3,385	$3,865	$6,155	$6,949	$12,735	$5,094	$11,394
Tested configuration includes	2MB RAM, 45MB hard disk, 1.2MB floppy disk drive, VGA monitor, 80387 coprocessor	4MB RAM, 140MB hard disk, 1.2MB and 1.44MB floppy disk drives, VGA monitor, 80387 coprocessor	2MB RAM, 40MB hard disk, 1.2MB floppy disk drive, EGA monitor	2MB RAM, 70MB hard disk, 1.2MB floppy disk drive, VGA monochrome monitor	8MB RAM, 155MB hard disk, 1.2MB floppy disk drive, VGA monitor, 80387-20 coprocessor	1MB RAM, 140MB hard disk, 1.2MB and 1.44MB floppy disk drives, VGA monitor	4MB RAM, 600MB hard disk, 1.2MB and 1.44MB floppy disk drives, VGA monitor, tower case
Microprocessor clock speeds	8/16 MHz	8/20 MHz	8/12/16 MHz	8/10/12/16 MHz	6/20 MHz	8/20 MHz	8/25 MHz
Bus clock speeds	8 MHz	8/10 MHz	8 MHz	8 MHz	8 MHz	8 MHz	8 MHz
Wait states	0, 1	0, 1	0	0	0, 1	0	0
Disk controller manufacturer and type (interface/encoding)	Omti (ST-506/ MFM)	Adaptec (ESDI)	Western Digital (ST-506/MFM)	NCR (ST-506/ MFM)	Western Digital (ESDI)	Adaptec (SCSI)	Adaptec (SCSI)
Number of drives handled by controller	4	4	4	4	4	5	5
BIOS version and date	AMI BIOS (January 1989)	AMI BIOS (January 1989)	Mitsubishi BIOS (1988)	NCR BIOS, Version 7.0 (March 1988)	Phoenix BIOS, Version 110.04 (June 1988)	AMI BIOS (1988)	AMI BIOS (1988)
System board manufacturer	AMI	AMI	Mitsubishi	NCR	NEC	Northgate	Northgate
386 chip set manufacturer	None (uses discrete logic)	None (uses discrete logic)	None (uses discrete logic)	None (uses discrete logic)	Intel	None (uses discrete logic)	None (uses discrete logic)
MEMORY SPECIFICATIONS							
Memory chip type	256Kb, 1Mb	1Mb	256Kb	256Kb	1Mb	256Kb	1Mb
Chip packaging	DIP	DIP	DIP, SIMM	DIP	DIP	SIMM	SIMM
RAM chips	DRAM, SRAM	DRAM, SRAM	DRAM	DRAM	DRAM	DRAM	DRAM
Interleaved memory	●	●	○	●	●	○	○
Shadow RAM	BIOS and video	BIOS and video	None	BIOS and video	BIOS and video	None	None
Type of cache controller	AMI (64K)	AMI (64K)	Mitsubishi (32K)	None	None	Northgate (64K)	Northgate (256K)
Disk cache software	●	●	●	●	●	●	●
Maximum RAM on motherboard	N/A**	8MB	2MB	N/A**	N/A**	6MB	8MB
Maximum 32-bit RAM	16MB	24MB	2MB	12MB	16MB	16MB	16MB
Maximum total system RAM	16MB	24MB	15.5MB	16MB	16MB	16MB	16MB
OTHER							
Warranty	18 months	18 months	1 year	1 year	1 year	1 year	1 year
FCC certification class	A	A	B	B	B	B	A

—Editor's Choice ●—Yes ○—No N/A*—Not applicable: the machine is not available in this configuration.
N/A**—Not applicable: RAM is located on memory cards rather than on the motherboard.

Olivetti USA—Olivetti M380/XP1	Pan-United Corp.—MicroLab 386/20	MicroLab 386/25	PC Designs Inc.—PC Designs 386-20 Plus	PC Link Corp.—PC Link 386-16	PC Link 386-20	Sanyo Business Systems Corp.—Sanyo MBC-16 Plus	Spear Technology Inc.—Spear 386A/16	Spear 386D/20	Tandon Corp.—Tandon 386	Tandy Corp.—Tandy 4000
$6,995	$3,197	$4,397	$2,799	$1,895	$2,295	$3,499	$1,790	$2,080	$4,199	$2,599
1MB RAM, 80MB hard disk, 1.2MB floppy disk drive, one serial and one parallel port	1MB RAM, 40MB hard disk, 1.2MB floppy disk drive, two serial and one parallel port	1MB RAM, 40MB hard disk, 1.2MB floppy disk drive, two serial and one parallel port	1MB RAM, 1.2MB floppy disk drive	1MB RAM, 1.2MB floppy disk drive, one serial and one parallel port	1MB RAM, 1.2MB floppy disk drive, one serial and one parallel port	1MB RAM, 1.2MB floppy disk drive, one serial and one parallel port, DOS 3.3	1MB RAM, 1.2MB floppy disk drive, one serial and one parallel port	1MB RAM, 1.2MB floppy disk drive, two serial and one parallel port	1MB RAM, 1.2MB floppy disk drive, DOS 3.3, *Microsoft Windows/386*	1MB RAM, 1.44MB floppy disk drive, one serial and one parallel port
3 half-height	5 half-height	5 half-height	5 half-height	5 half-height	5 half-height	3 half-height	5 half-height	5 half-height	5 half-height	4 half-height
$110/ Unavailable	$95/ Unavailable	$95/ Unavailable	$99/ Unavailable	$95/ Unavailable	$95/ Unavailable	Included/ Unavailable	$90/ Unavailable	$90/ Unavailable	Included/ Unavailable	$120/$325
1	7	7	0	95	95	3	9	9	2	9
Two 8-bit, two 16-bit, three 32-bit	One 8-bit, six 16-bit, one 32-bit	One 8-bit, six 16-bit, one 32-bit	Two 8-bit, four 16-bit, two 32-bit	Three 8-bit, four 16-bit, one 32-bit	Three 8-bit, four 16-bit, one 32-bit	Two 8-bit, four 16-bit	Two 8-bit, six 16-bit	Six 16-bit, two 32-bit	One 8-bit, four 16-bit	Two 8-bit, six 16-bit, one 32-bit
5	5	5	3	5	5	3	5	6	5	5
230 Front 72	200 Front 72	200 Front 72	200 Front 120	220 Front 72	220 Front 72	138 Rear 72	200 Front 92	200 Front 92	190 Front 60	192 Front 84
$7,360 (80MB disk)	$4,077	$5,277	$3,652	$2,950 (70MB disk)	$3,350 (70MB disk)	$4,222 (50MB disk)	$2,539	$2,829	$5,279 (40MB disk)	$4,868 (70MB disk)
$7,860 (80MB disk)	$4,607	$5,807	$4,405	$3,450 (70MB disk)	$3,850 (70MB disk)	N/A*	$3,031	$3,321	$6,147 (40MB disk)	$6,368 (70MB disk)
$8,579	$5,432	$8,607	$7,405	$4,795	$6,375	$6,421	$3,992	$4,676	$6,599	$5,047
2MB RAM, 80MB hard disk, 1.2MB floppy disk drive, VGA monitor	2MB RAM, 70MB hard disk, 1.2MB floppy disk drive, VGA monitor	4MB RAM, 150MB hard disk, 1.2MB floppy disk drive, VGA monitor	9MB RAM, 60MB hard disk, 1.2MB floppy disk drive, VGA monitor	2MB RAM, 40MB hard disk, 1.2MB floppy disk drive, VGA monitor, 80387 coprocessor	2MB RAM, 90MB hard disk, 1.2MB and 1.44MB floppy disk drives, VGA monitor, 80387 coprocessor	3MB RAM, 40MB hard disk, 1.2MB floppy disk drive, CGA monitor	4MB RAM, 44MB hard disk, 1.2MB floppy disk drive, VGA monitor	2MB RAM, 156MB hard disk, 1.2MB floppy disk drive, VGA monitor	2MB RAM, 110MB hard disk, 30MB removable hard disk, 1.2MB floppy disk drive, VGA monitor	2MB RAM, 40MB hard disk, 1.44MB floppy disk drive, VGA monitor
8/10/20 MHz	8/20 MHz	8/25 MHz	10/20 MHz	8/16 MHz	8/20 MHz	10/16 MHz	8/16 MHz	8/20 MHz	8/20 MHz	8/16 MHz
10 MHz	8 MHz	8 MHz	10 MHz	8 MHz	10 MHz	6 MHz	8 MHz	10 MHz	8 MHz	6/8 MHz
0	0	0	0, 1	0	0	0, 1	0	0	0	1
Western Digital (ST-506/MFM)	Western Digital (ST-506/MFM)	Western Digital (ESDI)	Adaptec (ESDI)	NCL (ST-506/MFM)	Western Digital (ESDI)	Data Technology Corp. (ST-506/MFM)	Everex (ST-506/MFM)	Data Technology Corp. (ESDI)	Tandon (ST-506/RLL)	Adaptec (SCSI)
3	4	4	4	4	4	3	4	4	3	4
Olivetti BIOS (April 1988)	AMI BIOS, Version 3.3 (September 1988)	AMI BIOS, Version 3.3 (September 1988)	AMI BIOS (September 1988)	Award BIOS, Version 3.0 3A (1988)	Award BIOS, Version 3.0 3A (1988)	Sanyo BIOS, Version 1.8 (November 1988)	AMI BIOS (1988)	AMI BIOS (1988)	AMI BIOS, Version 1.01 (1987)	Phoenix BIOS, Version 01.03.03 (February 1988)
Olivetti	AMI	AMI	PC Designs	Hauppauge	Hauppauge	Sanyo	Spear Technology/AMI	Spear Technology	AMI	Tandy
Intel/Olivetti	Chips and Technologies	Chips and Technologies	None (uses discrete logic)	Chips and Technologies	Chips and Technologies	Sanyo	None (uses discrete logic)	None (uses discrete logic)	Chips and Technologies	Intel
256Kb	256Kb	1Mb	256Kb, 1Mb	256Kb, 1Mb	256Kb, 1Mb, 4Mb	1Mb	256Kb, 1Mb	256Kb, 1Mb	256Kb	256Kb
SIMM	DIP, SIMM	DIP, SIMM	DIP, SIMM	DIP	DIP	SIP	DIP	DIP	SIMM	SIMM
DRAM	DRAM, SRAM, static column RAM	DRAM, static column RAM	DRAM	DRAM	DRAM	DRAM	DRAM	DRAM, static column RAM	DRAM	DRAM
●	○	○	○	●	●	○	○	○	●	●
BIOS	BIOS and video	BIOS and video	None	BIOS and video	BIOS and video	None	None	None	None	BIOS and video
None	AMI (64K)	AMI (64K)	None	None	None	None	Spear (64K)	None	Tandon (64K)	None
○	○	○	●	○	○	○	○	○	○	○
N/A**	16MB	16MB	1MB	1MB	1MB	1MB	4MB	1MB	8MB	8MB
48MB	16MB	16MB	16MB	1MB	1MB	1MB	4MB	17MB	8MB	16MB
64MB	32MB	32MB	16MB	15MB	64MB	15MB	16MB	17MB	16MB	16MB
90 days	1 year	1 year	1 year	1 year	1 year	1 year	1 year	1 year	1 year	1 year
B	B	B	A	B	B	A	B	B	B	B

Power



T5200: 20MHz 386 processor, 2 internal IBM®-compatible expansion slots, VGA gas plasma display with VGA monitor port, 40MB or 100MB hard disk, 2MB RAM standard expandable to 8MB, 1.44MB 3½" diskette drive.

At Toshiba, we're not only committed to making computers more portable, but also to making portables more powerful.

Which is why, in our effort to constantly improve and refine our machines, we've added three new computers to what is already the most complete family of truly portables available.

Each designed to be powerful enough to take on the increasingly complex tasks that face today's sophisticated PC users.

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Second, the T3100e, the successor to our most popular machine—the T3100/20. We've made it nearly two pounds lighter and a lot faster—we've even added expansion capabilities. About the only thing we didn't add was more size.

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T3100e: 12MHz 286 with 80287 co-processor socket, internal half-length IBM slot, 20MB hard disk with 27 msec access, 1MB RAM expandable to 5MB, gas plasma display, 1.44MB 3½" diskette drive.

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Toshiba America Inc., Information Systems Division

CIRCLE 321 ON READER SERVICE CARD

386-based PCs: Summary of Features

	Tandy Corp. Tandy 4000LX	PC Tandy 5000MC	Tatung Company of America Inc. Tatung TCS-8000	Televideo Systems Inc. TelOAS III 386/16	Tussey Computer Products Ltd. Swan 386/16	Swan 386/20D	Uniq Tech Inc. UTI 386/20
BASIC CONFIGURATION							
List price	$3,999	$4,999	$3,995	$3,599	$1,999	$2,199	$1,699
Basic configuration includes	2MB RAM, 1.44MB floppy disk drive, one serial and one parallel port	2MB RAM, 1.44MB floppy disk drive, one serial, one parallel, and one mouse port	1MB RAM, 1.2MB floppy disk drive, one serial and one parallel port, DOS 3.3	1MB RAM, 1.2MB floppy disk drive, two serial and one parallel port	1MB RAM, 1.2MB floppy disk drive; two serial, one parallel, and one game port	1MB RAM, 1.2MB floppy disk drive; two serial, one parallel, and one game port	1MB RAM, 1.2MB floppy disk drive
Drive bays	4 half-height	4 half-height	5 half-height	8 half-height	5 half-height	5 half-height	5 half-height
Cost of DOS 3.3/ OS/2 (if available)	$120/$325	$120/$325	Included/ Unavailable	$55/ Unavailable	$89/ Unavailable	$89/ Unavailable	$89/ Unavailable
Hard disk options	8	8	8	3	0	5	5
Slots	Two 8-bit, six 16-bit, one 32-bit	Three 16-bit, four 32-bit (MCA)	Two 8-bit, six 16-bit	Two 8-bit, ten 16-bit	Three 8-bit, four 16-bit, one 32-bit	Three 8-bit, four 16-bit, one 32-bit	Two 8-bit, four 16-bit, one 32-bit
Slots free with hard and floppy drives, video, two serial and one parallel port installed	5	8	5	9	4	4	4
Power supply (watts)	192	192	210	240	200	200	220
Reset switch	Front	Front	Front	Front	Front	Front	Front
Keyboard cable length (inches)	84	88	72	96	126	126	96
STANDARD CONFIGURATION							
Price of monochrome system with 1MB RAM, 60MB hard disk, DOS	$6,678 (2MB RAM, 70MB disk)	$7,198 (2MB RAM, 70MB disk)	$5,610 (40MB disk)	$4,674 (40MB disk)	$2,938 (80MB disk)	$3,138 (80MB disk)	$2,167
Price of VGA system	$6,897 (2MB RAM, 70MB disk)	$7,498 (2MB RAM, 70MB disk)	$6,440 (40MB disk)	$4,875 (40MB disk)	$3,437 (80MB disk)	$3,637 (80MB disk)	$2,866
TESTED CONFIGURATION							
List price	$6,947	$7,727	$7,885	$7,575	$3,533	$4,818	$3,205
Tested configuration includes	2MB RAM, 80MB hard disk, 1.44MB floppy disk drive, VGA monitor	2MB RAM, 80MB hard disk, 1.44MB floppy disk drive, VGA monitor	2MB RAM, 155MB hard disk, 1.2MB floppy disk drive, VGA monitor	4MB RAM, 40MB hard disk, 1.2MB floppy disk drive, VGA monitor	2MB RAM, 40MB hard disk, 1.2MB floppy disk drive, VGA monitor	2MB RAM, 150MB hard disk, 1.2MB floppy disk drive, VGA monitor	1MB RAM, 80MB hard disk, 1.2MB and 1.44MB floppy disk drives, VGA monitor
Microprocessor clock speeds	8/20 MHz	20 MHz	8/20 MHz	8/16 MHz	8/16 MHz	8/20 MHz	5/6/7/8/20 MHz
Bus clock speeds	8/10 MHz	10 MHz	8 MHz	8 MHz	8 MHz	8 MHz	5/6/7/8/20 MHz
Wait states	1	0	0, 1	0	0, 1	0, 1	0, 1
Disk controller manufacturer and type (interface/encoding)	Adaptec (SCSI)	Adaptec (ST-506/MFM)	Western Digital (ESDI)	Western Digital (ST-506/RLL)	National Computer Ltd. (ST-506/MFM)	Adaptec (ESDI)	Data Technology Corp. (ST-506/ MFM)
Number of drives handled by controller	4	4	4	4	4	4	4
BIOS version and date	Phoenix BIOS, Version 01.04.01 (November 1988)	Phoenix BIOS, Version 01 01.04 (October 1988)	Phoenix BIOS Plus, Version 1.10 (January 1988)	Televideo BIOS (September 1988)	Phoenix BIOS Plus, Version 1.10 (January 1988)	Phoenix BIOS Plus, Version 1.10 (January 1988)	AMI BIOS (1987)
System board manufacturer	Tandy	Tandy	Tatung	Televideo	Swan	Twinhead International	Orchid
386 chip set manufacturer	Intel	Intel	Chips and Technologies	Chips and Technologies	Chips and Technologies	Chips and Technologies	Chips and Technologies
MEMORY SPECIFICATIONS							
Memory chip type	256Kb	256Kb	256Kb, 1Mb	256Kb	256Kb, 1Mb	256Kb, 1Mb	256Kb
Chip packaging	SIMM	SIMM	SIMM	SIMM	SIMM	SIMM	DIP
RAM chips	DRAM	DRAM	DRAM	DRAM	DRAM	DRAM	Static column RAM
Interleaved memory	●	●	●	●	●	●	●
Shadow RAM	BIOS and video	BIOS and video	None	None	BIOS and video	BIOS and video	BIOS and video
Type of cache controller	None	Intel 82385 (32K)	None	None	None	None	None
Disk cache software	○	○	○	○	○	○	○
Maximum RAM on motherboard	6MB	N/A**	16MB	16MB	16MB	16MB	6MB
Maximum 32-bit RAM	16MB	16MB	16MB	16MB	16MB	16MB	6MB
Maximum total system RAM	16MB	16MB	16MB	32MB	16MB	16MB	16MB
OTHER							
Warranty	1 year	1 year	1 year	1 year on-site service	1 year	1 year	1 year
FCC certification class	A	A	B	A	A	A	B

PC—Editor's Choice ●—Yes ○—No N/A*—Not applicable: the machine is not available in this configuration.
N/A**—Not applicable: RAM is located on memory cards rather than on the motherboard.

	VIPC Computers Corp.			VNS America Corp.	Wang Laboratories Inc.		Wyse Technology	Zenith Data Systems	Zeos International Ltd.		
	VIPC 386/16	VIPC 386/20	VIPC 386/25	SIVA AT386	Wang 381	Wang 382	Wyse pc386	Zenith Z-386/25	Zeos 386-16	Zeos 386-20	Zeos 386-25
	$1,499	$1,999	$2,999	$1,845	$2,900	$3,155	$3,599	$6,599	$1,945	$2,545	$3,545
	1MB RAM, 1.2MB floppy disk drive, one parallel port	1MB RAM, 1.2MB floppy disk drive, two serial and two parallel ports	1MB RAM, 1.2MB floppy disk drive, one parallel port	1MB RAM, 1.2MB floppy disk drive, two serial and one parallel port, tower case	1MB RAM, 1.2MB floppy disk drive	1MB RAM, 1.2MB floppy disk drive	1MB RAM, 1.2MB floppy disk drive, two serial and one parallel port, DOS 3.3	2MB RAM, 1.44MB floppy diek drive, two serial and one parallel port, DOS 3.3	1MB RAM, 1.2MB floppy disk drive, one serial and one parallel port	1MB RAM, 1.2MB floppy diek drive, one serial and one parallel port	1MB RAM, 1.2MB floppy disk drive, one serial and one parallel port, tower case
	5 half-height	6 half-height	6 half-height	6 half-height	4 half-height	4 half-height	5 half-height	4 half-height	3 half-height	5 half-height	6 half-height
	$99/ Unavailable	$99/ Unavailable	$99/ Unavailable	$70/ Unavailable	$100/ Unavailable	$100/ Unavailable	Included/ $325	Included/ $299	$99/ Unavailable	$99/ Unavailable	$99/ Unavailable
	6	6	6	4	5	5	3	3	10	10	10
	Two 8-bit, five 16-bit, one 32-bit	One 8-bit, six 16-bit, one 32-bit	Two 8-bit, five 16-bit, one 32-bit	Two 8-bit, five 16-bit, one 32-bit	Two 8-bit, six 16-bit, one 32-bit	Two 8-bit, six 16-bit, one 32-bit	Three 8-bit, six 16-bit, two 32-bit	Three 16-bit, four 32-bit	One 8-bit, six 16-bit, one 32-bit	One 8-bit, six 16-bit, one 32-bit	One 8-bit, six 16-bit, one 32-bit
	5	7	5	5	6	6	5	4	6	6	5
	230	230	230	220	229	229	220	200	200	230	200
	Front	Front	Front	Front	None	None	None	None	Front	Front	Front
	90	80	72	96	144	144	72	96	72	72	72
	$2,099	$2,599	$3,599	$2,195 (40MB disk)	$6,210 (68MB disk, VGA monochrome monitor)	$6,445 (68MB disk, VGA monochrome monitor)	$7,563 (85MB disk)	N/A*	$2,598 (65MB disk)	$3,093 (65MB disk)	$4,093 (65MB disk)
	$2,499	$2,999	$3,999	$2,890 (40MB disk)	$6,640 (68MB disk)	$6,875 (68MB disk)	$8,267 (65MB disk)	$9,698 (2MB RAM, 70MB disk)	$3,293 (65MB disk)	$3,788 (65MB disk)	$4,788 (65MB disk)
	$3,499	$4,199	$6,999	$4,895	$6,595	$6,795	$11,849	$10,298	$3,764	$4,483	$7,037
	4MB RAM, 44MB hard disk, 1.2MB floppy disk drive, VGA monitor, tower case	4MB RAM, 80MB hard disk, 1.2MB floppy disk drive, VGA monitor, tower case	8MB RAM, 155MB hard disk, 60MB tape backup, 1.2MB and 1.44MB floppy diek drives, VGA monitor, 80387-25 coprocessor, tower case	4MB RAM, 80MB hard disk, 1.2MB and 1.44MB floppy disk drives, VGA monitor, 80387-20 coprocessor	2MB RAM, 42MB hard disk, 1.2MB and 1.44MB floppy disk drives, VGA monitor	2MB RAM, 42MB hard disk, 1.2MB and 1.44MB floppy disk drives, VGA monitor	4MB RAM, 85MB hard disk, 60MB tape backup, 1.2MB floppy disk drive, VGA monitor	2MB RAM, 150MB hard disk, 1.44MB floppy disk drive, VGA monitor	2MB RAM, 40MB hard disk, 1.2MB floppy disk drive, VGA monitor	2MB RAM, 65MB hard disk, 1.2MB floppy disk drive, VGA monitor	4MB RAM, 65MB hard disk, 1.2MB and 1.44MB floppy disk drives, VGA monitor, tower case
	4.77/6/8/16 MHz	8/20 MHz	4.77/6/8/25 MHz	16/20 MHz	8/16 MHz	8/20 MHz	8/16 MHz	25 MHz	8/16 MHz	8/20 MHz	8/25 MHz
	6 MHz	8 MHz	6.3/12.5 MHz	8/10 MHz	6 MHz	6 MHz	6 MHz	6 MHz	6 MHz	6 MHz	6.33 MHz
	0	0	3, 4	0	0	0	0, 1	0	0	0	0
	Konan (ST-506/ MFM)	Konan (ST-506/ MFM)	Konan (ST-506/ MFM)	Scientific Micro Systems (ST-506/MFM)	Wang (ST-506/ MFM)	Wang (ST-506/ MFM)	Western Digital (ESDI)	Data Technology Corp. (ESDI)	Adaptec (ST-506/MFM)	Adaptec (ST-506/RLL)	Distributed Processing Technology (ST-506/RLL)
	4	4	4	4	4	4	4	4	4	4	4
	Phoenix BIOS Plus, Version 110 (January 1988)	Quadtel BIOS (1988)	Phoenix BIOS, Version 4.01 (1988)	AMI BIOS (January 1988)	Phoenix BIOS Plus, Version 1.10 03 (1988)	Phoenix BIOS Plus, Version 1.10 03 (1988)	Phoenix BIOS, Version 3.53 (1988)	Zenith BIOS	AMI BIOS II (September 1988)	AMI BIOS II (September 1988)	AMI BIOS II (September 1988)
	Micronics	AMR	Micronics	SIVA/VNS America	Wang	Wang	Wyse	Zenith	AMI	AMI	AMI
	Intel	Intel	Chips and Technologies	Chips and Technologies	Chips and Technologies	Chips and Technologies	None (uses discrete logic)	Zenith	Chips and Technologies	Chips and Technologies	Chips and Technologies
	256Kb	256Kb	1Mb	1Mb	256Kb, 1Mb	256Kb, 1Mb	256Kb	1Mb	256Kb	256Kb	1Mb
	DIP	DIP, SIMM	DIP	DIP	SIMM	SIMM	DIP	SIMM	DIP	DIP, SIMM	DIP
	SRAM	DRAM	DRAM	DRAM, static column RAM	DRAM	DRAM	DRAM	DRAM	DRAM	DRAM	DRAM
	○	●	○	●	●	●	●	○	○	○	○
	●	●	●	BIOS and video	BIOS and video	BIOS and video	○	BIOS and video	BIOS and video	BIOS and video	BIOS and video
	None	None	Intel 82335 (64K)	None	None	None	None	Zenith (64K)	Zeos (64K)	Zeos (64K)	Zeos (64K)
	○	○	○	○	○	○	●	○	○	○	4○
	N/A**	2MB	N/A**	16MB	N/A**	N/A**	N/A**	8MB	N/A**	32MB	32MB
	16MB	16MB	16MB	16MB	16MB	16MB	8MB	32MB	64MB	96MB	96MB
	16MB	16MB	16MB	16MB	16MB	16MB	16MB	32MB	64MB	96MB	96MB
	1 year	1 year	1 year	1 year	1 year	1 year	1 year	1 year	1 year	1 year	1 year
	B	B	A	A (pending)	B	A	B	B	A	A	A

SANYO BUSINESS SYSTEMS CORP.
SANYO MBC-18 PLUS

Sanyo's small-footprint 386 PC, the MBC-18 Plus, seems to be designed for customers with modest expectations, good eyesight, and either a clear understanding of their future needs or a reliable dealer.

You'll need modest expectations because you'll have one of the slower-performing 16-MHz machines, with only three slots left for expansion after you add a hard disk controller and a video card. You'll need good eyesight because the only color video card Sanyo sells is a primitive CGA adapter. And you'll need either a clear understanding of your future needs or a good dealer because you probably won't want to brave the inside of this unconventionally built machine to install any options on your own.

Sanyo's pricey $3,499 basic configuration gives you 1MB of zero-wait-state 85-nanosecond RAM, a 1.2MB floppy disk drive, a serial and a parallel port, and MS-DOS 3.3 and GW-BASIC. For $1,699 more, you can add 2MB RAM on an expansion card that lets you plug in a total of 14MB.

Sanyo offers a 25MB hard disk for $479, a 40MB disk for $799, and a 50MB disk for $549. The 40MB disk costs more than the 50MB because it has a 28-millisecond access time, while the larger one trails behind at 45 ms.

If you decide to install these or any options without your dealer's help, you'll have to remove the system's top panel and hold it with one hand while you simultaneously remove both of the now-loosened side panels. If you want access to the three drive bays, you must first unscrew the front panel, then confront an inner metal cover that blocks the expansion slots.

Sanyo's 386 seems aimed at users with modest needs.

Sanyo uses a backplane design, with the CPU, 1MB of RAM, and the serial and parallel ports and floppy disk drive controller on a system board in one of the six available slots. If you want to install an 80387, you must first detach a small tangle of unlabeled wires that obstruct the board at the top.

To install any more 32-bit RAM, you plug Sanyo's proprietary memory board into the adjacent 8-bit slot and fit a 32-bit connector at the top of the memory board into the system board. That leaves you with one 8-bit and three 16-bit slots free. One slot takes a hard disk controller, and another takes a video card. Sanyo sent us a system with an 8-bit Scurry Magic VGA card and a Goldstar monitor, but the company will sell you only a monochrome card or a combination monochrome/CGA card that can give you CGA graphics on a color or monochrome monitor.

Sanyo supplies its own Enhanced-style keyboard, which has a loose touch, and its own BIOS. Earlier models of Sanyo's BIOS were notorious for software incompatibilities, but we had no trouble with this version. If an application should ever lock up, though, be careful when pressing the reset switch in the back. The switch is deeply recessed in an opening that you can reach only with a narrow object like a ballpoint pen. Because the opening also gives access to a block of DIP switches, you can easily hit one of these by mistake and reconfigure the computer without noticing that you've done anything wrong.

—Edward Mendelson

The small footprint of the 16-MHz Sanyo MBC-18 Plus is welcome, but the unit is limited. The machine has only six slots, and the only color video card Sanyo sells is a CGA. In addition, the unconventional design makes it unlikely that you'll want to add future options on your own.

PC MAGAZINE FACT FILE

Sanyo MBC-18 Plus
Sanyo Business Systems Corp.
Computer Division
51 Joseph St.
Moonachie, NJ 07074
(201) 440-9300
(800) 524-1021
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, DOS 3.3, $3,499; with 50MB hard disk, monochrome monitor, $4,222; with CGA monitor, $4,472; with 3MB RAM, 40MB hard disk, $6,421. 2MB RAM upgrade, $1,699.
In Short: Sanyo's small-footprint 16-MHz machine is an undistinguished performer with limited options (no EGA or VGA) and an inconvenient nonstandard physical layout. The price is on the high side for this class of computer.
CIRCLE **627** ON READER SERVICE CARD

SPEAR TECHNOLOGY INC.
SPEAR 386A/16
SPEAR 386D/20

From the outside, Spear Technology's two 386 machines—the 386A/16 and the 386D/20—are indistinguishable from one another. Both have a sturdy, AT-style cover and a front panel sporting the usual LED indicators and reset button, and both use the Mitsumi Electric keyboard, a good model with a springy feel to it. Likewise, the 16- and 20-MHz systems come with equally attractive base price tags—$1,790 and $2,080, respectively.

The machines also share a number of functional similarities. During a cold boot, pressing Esc will terminate the RAM check—a useful shortcut. Pressing Del after the hardware self-test will call up the

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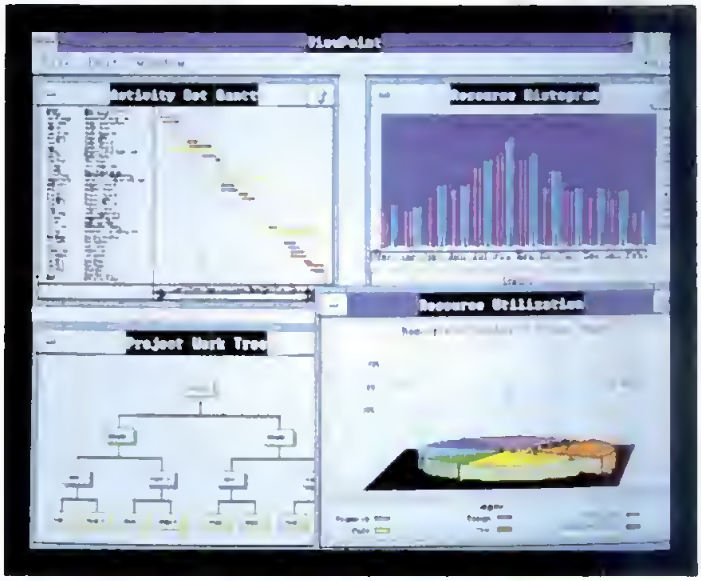

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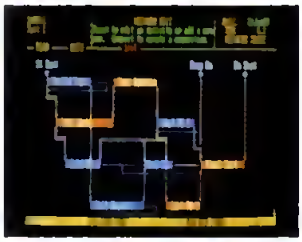

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INFO WORLD
BEST IN ITS CLASS

Like its look-alike 16-MHz counterpart, Spear Technology's 20-MHz Spear 386D/20 allows you to set the six 16-bit slots to either one or two wait states, for speed or compatibility. You do get an AT-style case, but the location of the co-processor socket under the hard drive is a design flaw.

setup program embedded in ROM. And you can shift the systems between high speed and 8 MHz at any time from the keyboard.

Both machines use an AMI BIOS. They come with DOS 3.3 and GW-BASIC, but you don't get any extras such as diagnostics software or a disk-caching utility. OS/2 isn't an option either.

SPEAR 386A/16 Under its cover, the 386A reveals a sturdy chassis and generally solid workmanship, although a jumper fix was visible on the motherboard. There are two 8-bit slots and six 16-bit slots, all full-length. One hard disk and one single high-density floppy disk drive were included in our $3,615 test configuration, leaving three empty half-height drive bays. An Everex MFM disk controller, an 8-bit Orchid VGA card, and a parallel and serial port card filled three slots, leaving ample room for expansion.

The 386A runs at a constant bus speed of 8 MHz, while the 386D's bus speed is fixed at 10 MHz. Both machines, however, have the unusual ability to allow you to set the 16-bit bus slots at one or two wait states, allowing you to choose between optimal speed and compatibility. The 386A also allows you to select from four, five, or six wait states for the 8-bit bus slots.

You have the option of ordering either 1MB or 4MB of 32-bit RAM on the Spear Technology/AMI motherboard. While you can bring the total system RAM up to 16MB, the lack of any 32-bit slots means that the additional memory can be added only via 16-bit expansion boards, something of a drawback. A 64K static RAM cache with proprietary cache controller helps maintain the unit's zero-wait-state performance.

The DIP switches on the unit are fairly accessible. Unfortunately, though, the socket for an optional 80287 coprocessor is not. It is hidden under the hard disk, which you must remove before inserting the chip.

While the 44MB Seagate drive turned in a middling access time of just under 40 milliseconds on our benchmark test, in most of our BIOS Disk Seek tests, the 386A proved itself a good performer.

SPEAR 386D/20 The 386D differs from its sibling in more than just processor speed. It offers six full-length 16-bit expansion slots and two proprietary 32-bit slots for memory cards. Two slots on the $4,676 test unit were taken up by the VGA card and a DTC ESDI controller, while one parallel and two serial ports were mounted on the proprietary motherboard, saving a slot.

A 156MB ESDI Toshiba hard disk filled two of the five half-height drive bays. The disk displayed a respectable access time of just under 24 ms, but unfortunately failed to operate when running the CPU at 8 MHz. A tech support person at Spear said that this problem was caused by the ESDI controller, and that the only way to gain access to the disk at both speeds was to reformat it with a 2:1 interleave instead of the optimal 1:1 interleave.

The motherboard can hold only 1MB of RAM, but you can add memory via proprietary 32-bit boards with 1-, 2-, 4-, or 8MB capacities. There's no memory cache or interleaving, but a page-mode scheme speeds up the 60-nanosecond chips.

Although the 386D delivered fair performance on most of our benchmark tests, it took an inordinately long time to run the extended memory read and write tests (rendering this RAM unusable). Spear Technology told us that this was because a jumper had been incorrectly set to make use of a math coprocessor that wasn't installed.

Resetting the jumper solved the problem (though not in time for testing), but since it was located under the hard disk, it required deft maneuvering with a pair of pliers and a flashlight. The company admitted that a number of units had been shipped with the jumper set in the wrong position and that the settings were incorrectly documented in the manual.

As with the 386A, the coprocessor socket is inconveniently placed under the hard disk drive. A set of DIP switches is also partially hidden by the hard disk.

While the prices for the Spear Technology 386s are pleasingly reasonable, the problems we encountered with the 386A during our tests did not inspire confidence in the reliability of this company.

—Robert Kendall

PC MAGAZINE FACT FILE

Spear Technology Inc.
710A Landwehr Rd.
Northbrook, IL 60062-2310
(800) 282-1212
(312) 480-7300

Spear 386A/16
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, $1,790; with 60MB hard disk, monochrome monitor, DOS 3.3, $2,539; with VGA color monitor, $3,031; with 4MB RAM, 44MB hard disk, $3,992. 1MB RAM upgrade, $345; 60MB tape backup, $599; 150MB hard disk, $1,374.

CIRCLE **653** ON READER SERVICE CARD

Spear 386D/20
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, $2,080; with 60MB hard disk, monochrome monitor, DOS 3.3, $2,829; with VGA color monitor, $3,321; with 2MB RAM and 156MB hard disk, $4,676. 1MB RAM upgrade, $600; 60MB tape backup, $599; 150MB hard disk, $1,374.

CIRCLE **654** ON READER SERVICE CARD

In Short: The Spear 386A/16 and 386D/20 offer attractive prices, flexible configuration options, and good performance in most areas. We did encounter a couple of problems in getting the 386D/20 to run properly, though.

We had these two talking in no time at all.

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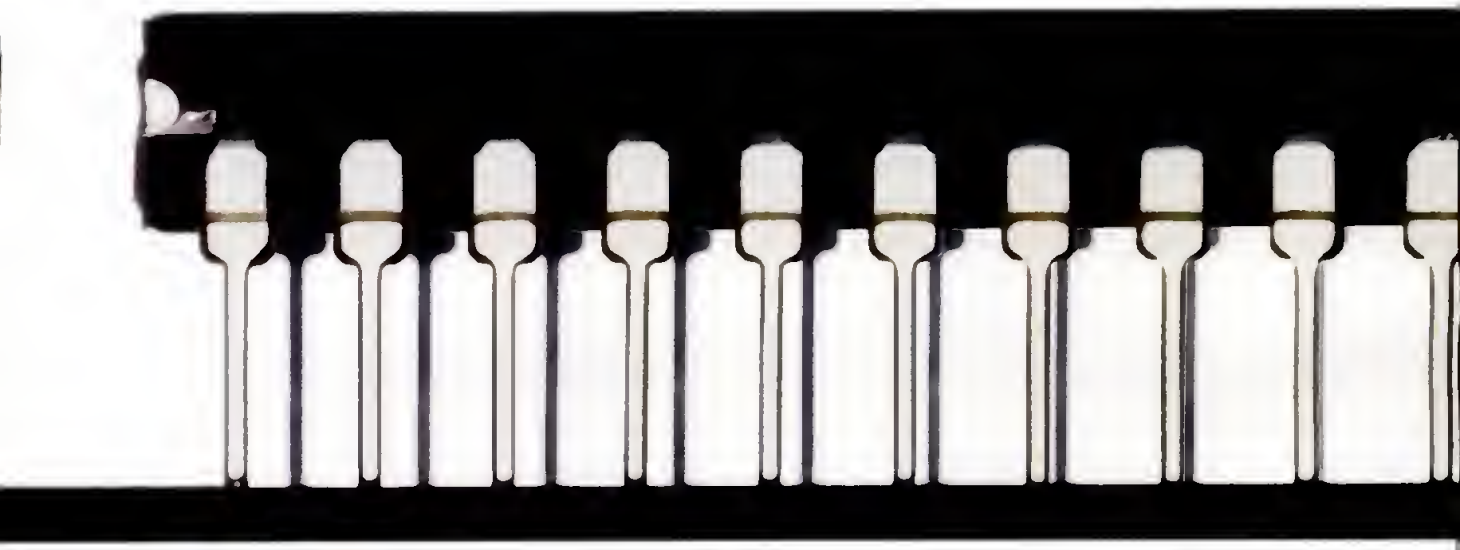

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CIRCLE 517 ON READER SERVICE CARD

TANDON CORP.
TANDON 386

The world is populated with peripatetic individuals who want not only to enjoy their mobility but also to transport their "stuff" with them. Here's a computer that allows you to have your data and carry it home, too.

The Tandon 386 is base-priced at $4,199, but fully configured with Tandon's own equipment, including a color monitor, an EGA Card, a 110MB hard disk, and a 30MB Personal Data Pac, our test unit cost $6,599.

The Personal Data Pac is a durable, efficient, removable drive powered by an RLL controller with a 128K built-in cache; it's roughly the size of one of those zucchini breads your neighbors keep forcing on you, but immensely more useful.

Other noteworthy features on the Tandon machine include built-in 64K caching, with zero-wait-state operation, and 100-nanosecond 256-kilobit DRAM SIMM chips on the motherboard (the test system had 2MB using 256Kb chips, but up to 8MB of 32-bit memory is possible with 1-megabit chips).

On the downside, there's no 32-bit slot to accommodate a card with additional memory, although one is planned for a future release. Also, the Data Pac is both ejected and protected from ejection by software. But if you can no longer access your hard disk, you'll have to remove the cover and use some elbow grease. It's possible with a little effort, but you may find it frustrating.

The Tandon 386 includes a 30MB Personal Data Pac, the company's own durable, removable hard disk drive, to make moving data easy and efficient. The Data Pac is powered by an RLL controller with 128K cache.

ALL BUNDLED UP Tandon DOS 3.3 is included in the bundled software. One problem, though: Tandon DOS 3.2 was on the Data Pac, and Tandon DOS 3.3 was on the hard disk. As of this writing, all the Tandon systems are being shipped this way. A quick SYS and copy of COMMAND.COM put them both on an even keel with DOS 3.3. In addition, the company has included the checksum for the Tandon MS-DOS utility files. Checksums are of interest to programmers and to those wanting to keep a record of files to protect them from possible virus attack.

You'll also have at least one instant 386 application: *Microsoft Windows/386* Presentation Manager. Other software includes GW-BASIC, EGA Card utilities, and Data Pac utilities. The Data Pac utilities allow hotkey eject customization, copying from one Data Pac to another, setup of your RLL controller, and head parking for both the Data Pac and your conventional disk.

Play it safe when it comes to accessing your DataPac; also, be sure to install the DPACCESS driver on your boot directory and call it from your CONFIG.SYS file. Tandon has supplied this driver because its version of DOS 3.3 requires it, and also in case the computer is used with a version of DOS or another environment, like OS/2, that does not support removable drives.

The Tandon 386 was no speed demon on our benchmark tests, but it did beat out approximately one-third of the other 20-MHz 386 computers tested.

But if what you're looking for is a 16-MHz model, Tandon also offers a 16-MHz (switchable to 8-MHz) 386 machine with or without a 40MB hard disk; the 64K RAM cache is optional. Prices for the Tandon 386/16 are $3,599 without a hard disk and $4,399 with the 40MB hard disk.

Overall, you'll find the 20-MHz Tandon 386 a solid machine, especially for those wanting the security of a removable hard disk. You can work on your sensitive data during the day and then store it away from curious eyes in your safe at night. Other pluses include the bundled utilities and software, as well as clear documentation. However, you just might want to wait until Tandon comes out with the 32-bit-memory-slot version.

—Pamela J. Milland

PC MAGAZINE FACT FILE

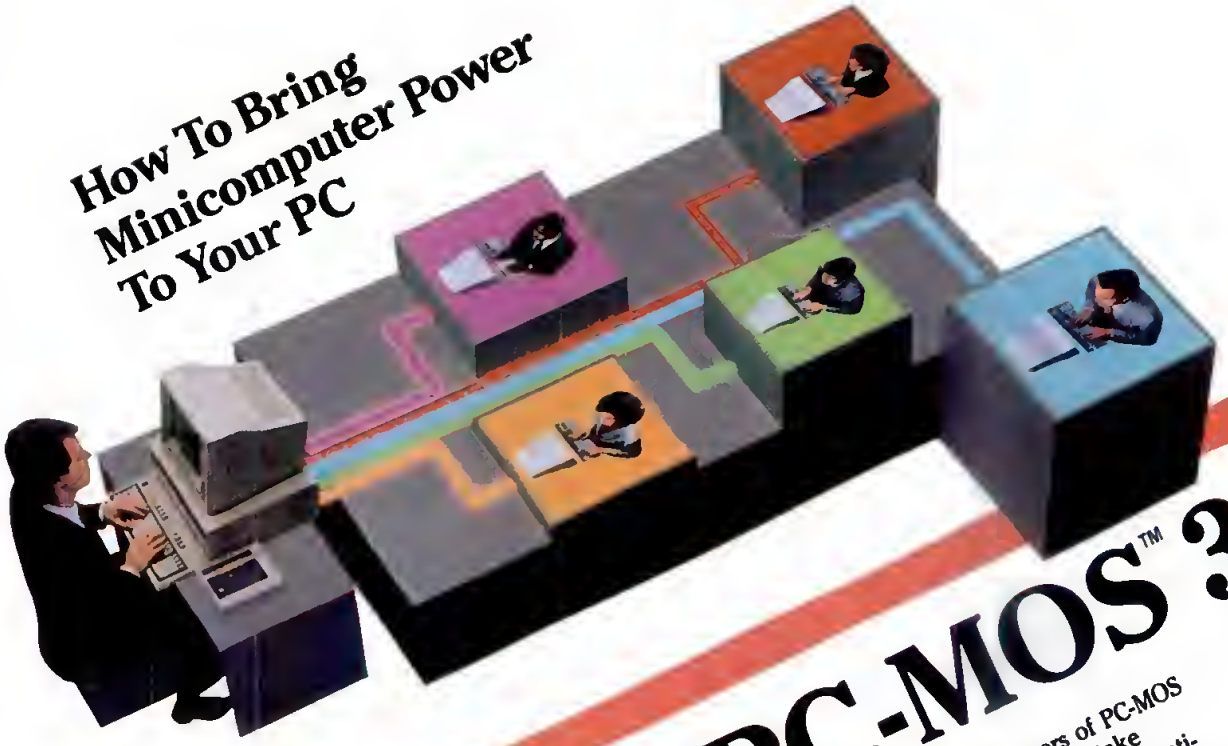
Tandon 386
Tandon Corp.
405 Science Dr.
Moorpark, CA 93021
(800) 228-8595
(805) 378-3068
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, DOS 3.3, $4,199; with 40MB hard disk, monochrome monitor, $5,279; with VGA monitor, $6,147; with 2MB RAM, 110MB hard disk, receptacle for removable 30- or 40MB Personal Data Pac, $6,599. 1MB RAM upgrade, $665.
In Short: A reliable 386 with adequate speed, the Tandon 386 has more options than most candy-store kids could want; but this kid still wishes for a 32-bit slot. The high-end version is a data security specialist's dream with a removable 30MB Personal Data Pac.
CIRCLE 658 ON READER SERVICE CARD

TANDY CORP.
TANDY 4000
TANDY 4000LX
TANDY 5000MC

When Tandy recently introduced the 5000MC, it became the first company to release a machine compatible with IBM's Micro Channel architecture (MCA). The system is the newest of Tandy's three 386 machines, right behind its two conventional AT-bus PCs, the 16-MHz Tandy 4000 and the 20-MHz Tandy 4000LX.

The base price of each of the machines—$2,599 for the 4000, $3,999 for the 4000LX, $4,999 for the 5000MC—includes a floppy disk controller, a 1.44MB

How To Bring Minicomputer Power To Your PC



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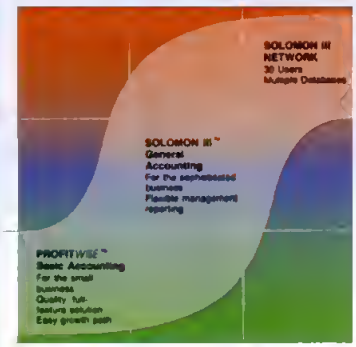

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CIRCLE 747 ON READER SERVICE CARD

3½-inch floppy disk drive, a 101-key keyboard, one serial and one parallel port, and a 192-watt power supply with four device connectors for the four possible half-height storage devices. DOS and BASIC are $120 options; Tandy also sells OS/2 1.0 for $325.

Almost all of the components are manufactured in-house, including motherboards, cases, power supplies, keyboards, floppy disk drives, and monitors. Like IBM and Epson, Tandy has a company policy against verbally identifying other component sources, even when the vendors' names are visible on the component. Our survey of the test machines revealed hard disk controllers from Adeptec in all three, video adapter cards that appear to be based on Paradise chips in the 4000 systems, and a CDC hard disk on the 5000MC. All three machines used Intel chip sets and 1988 versions of Phoenix ROM BIOS.

The Tandy 5000MC is the first IBM Micro Channel–compatible machine to hit the market as well as the company's second 20-MHz 386, joining its AT-bus model 4000LX. Almost all the components are manufactured in-house, including motherboards, keyboards, and monitors.

TANDY 4000 The Tandy 4000 is a fairly conventional 16-MHz 386 computer. The base model comes with 1MB of 100-nanosecond DRAM SIMM memory chips (64K is allocated to shadow RAM to improve video and system BIOS performance), runs at one wait state, and uses 1:1 page-mode memory interleaving. The default bus speed is 8 MHz, but conservative types will appreciate being able to switch to 6 MHz.

Slotwise, you get space for two 8-bit and six 16-bit boards, as well as Tandy's $179 32-bit memory expansion card, which can accommodate 8MB of RAM. Combined with the 8MB of 32-bit RAM you can squeeze onto the motherboard, the total system memory capacity comes to a generous 16MB. Be warned, though: Tandy charges a whopping $649 for each 1MB SIMM pack—more than most other vendors.

The floppy disk drive controller, capable of supporting two drives, is built into the motherboard. The motherboard will support an 80387 chip, as well as the Weitek 1167 and 3167 coprocessors.

The test machine, priced at $5,047, included an SCSI Adaptec controller, 2MB of RAM, a 40MB 19-millisecond hard disk, and a very fine .31-mm dot pitch VGA monitor with an 8-bit VGA card. In general, the Tandy 4000 did reasonably well on all the benchmark tests, coming out with roughly average scores.

TANDY 4000LX The 20-MHz 4000LX mirrors the 4000 in its motherboard and its slot and memory configurations. Of course, the 4000LX's processor hums along at a speedier 20 MHz, settable to 8-MHz with software. And 2MB of 80-nanosecond RAM are included in the base price. You'll be grateful for the additional megabyte of memory, as upgrades for this machine come in 2MB bunches costing up to $1,499 per bunch. Ouch!

The default bus speed is 8 MHz, but with software you can bump it to 10 MHz, which you should do immediately. While there's no memory caching, speedier performance is achieved through the allocation of 64K to shadow RAM and the second megabyte of RAM to interleaved memory.

The 4000LX comes with the same overly soft 101-key keyboard as the 4000. But unlike its 16-MHz counterpart, which enjoys an FCC Class B rating, the 4000LX is certified only for office use.

The evaluation unit, priced at $6,947, included an 80MB hard disk and the same VGA controller and monitor found in the 4000. The hard disk included in the test model was rated at 28 ms., but Tandy says that the 80MB drives now sold are rated at a faster 19 ms.

In benchmark tests, though, the 4000LX performed a bit below average, lagging behind other 20-MHz units.

TANDY 5000MC Our processor and memory tests showed the 5000MC to be in the top bunch of 20-MHz computers. The unit's base price is a full $1,000 higher than the 4000LX's, but some components that are not standard in the other system, such as a mouse port and VGA card, are built directly into the 5000MC's motherboard. Also built into the motherboard are the serial and parallel ports and the floppy disk controller. This space-saving approach leaves three 16-bit slots and three 32-bit MCA slots available. The fourth 32-bit slot holds the system's memory expansion board.

The standard configuration includes 2MB of 100-ns. SIMM chips and an 82835 memory cache controller chip with 32K of 35-ns. cache memory on the 32-bit expansion card. Memory interleaving, a fixed 10-MHz bus speed, and zero wait states are also hallmarks of this machine. The keyboard is the best Tandy keyboard I've ever worked with; it has sufficient response and click to let you know you've done something when you touch a key.

Tandy brings the car salesman's concept of "preferred options packages" to the computer world. Buying a unit preconfigured with one of Tandy's standard set of options can cost less than adding on the individual components later. For $7,727, you can get a prepackaged system equipped, as our test unit was, with an 80MB 16-ms. CDC hard disk, a .31-mm-dot-pitch VGA monitor, and DOS.

The only drawback to the 5000MC is a flimsy plastic rod that extends from the

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CIRCLE 313 ON READER SERVICE CARD

■ 80386 DESKTOP PCs

PC MAGAZINE FACT FILE

Tandy Corp.
1800 One Tandy Center
Fort Worth, TX 76102
(817) 390-3700

Tandy 4000
List Price: With 1MB RAM, 1.44MB 3½-inch floppy disk drive, $2,599; with 70MB hard disk, monochrome monitor, DOS 3.3, $4,868; with VGA monitor, $5,368; 2MB RAM, 40MB hard disk, $5,047. 1MB RAM upgrade, $829; 40MB tape backup, $549.
CIRCLE 628 ON READER SERVICE CARD

Tandy 4000LX
List Price: With 2MB RAM, 1.44MB 3½-inch floppy disk drive, $3,999; with 70MB hard disk, monochrome monitor, DOS 3.3, $6,678; with VGA monitor, $6,897; with 2MB RAM, 80MB hard disk, $6,947. 40MB tape backup, $549.
CIRCLE 629 ON READER SERVICE CARD

EDITOR'S CHOICE

Tandy 5000MC
List Price: With 2MB RAM, 1.44MB 3½-inch floppy disk drive, $4,999; with 70MB hard disk, monochrome monitor, DOS 3.3, $7,198; with VGA monitor, $7,498; with 2MB RAM, 80MB hard disk, $7,727. 1MB RAM upgrade, $749; 40MB tape backup, $549.
CIRCLE 630 ON READER SERVICE CARD

In Short: Tandy's 386 computers start out attractively priced, but adding everything from a hard disk on up gets expensive. The best deal here is the 16-MHz offering, but the 5000MC is compelling as well, because it's the first MCA compatible to make it to market. The 5000MC also has the best keyboard on a Tandy since the Model 1000 and a larger footprint for those who want MCA and room to expand along with it.

front power switch to the back of the machine, where it mechanically pushes another switch to turn the system on. While this didn't cause any problems during our tests, it sure looked as if the rod could easily detach from its connecting parts.

Tandy's strongest point is its thousands of retail outlets. While you can purchase these 386s only at Tandy Centers or authorized dealer franchises, you can take them to any of the roughly 7,000 Radio Shack retail locations for service.

The AT-bus machines are good, but the

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tirely. As for speed, *Fastback Plus* is ready for the next backup diskette before you finish labeling the one you just removed.

Fastback Plus takes the guesswork out of the backup process by showing subdirectories and their contents on a split screen. Files can be selected for backup by name, date range, directory, or archive bit, or they can be marked individually. A particularly nice feature is *Fastback*'s ability to estimate the

PC MAGAZINE

BYTE AWARDS

Fastback Plus

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PC WORLD

EXECUTIVE SUMMARY

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Backup selectivity				●
Security				●
Floppy disk handling				●
Overall value				●

Fastback Plus 2.01: No More Backup Excuses

HANDS ON

BY EDWARD MENDELSON

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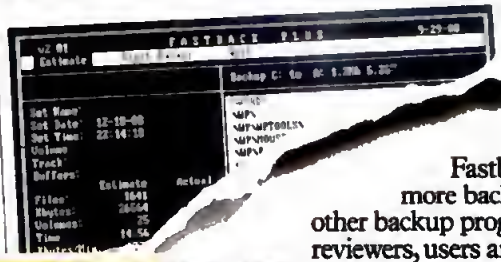

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Fifth Generation SYSTEMS, INC

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CIRCLE 286 ON READER SERVICE CARD

EDITOR'S CHOICE HARDWARE PL

PC MAGAZINE

EDITOR'S CHOICE

"The Portacomp II is a value leader with memory, a fast drive controller and a terrific keyboard ...Marvelously cheap, powerful alternative ...outperformed the other 286's." (Oct. 11, 1988)

PC MAGAZINE

"The Dataworld 286(12MHz) AT compatible (is) the fastest machine of the nine tested in the review" (Sep. 27, 1988)

PC MAGAZINE

EDITOR'S CHOICE

"The Dataworld offers a 16-bit video system with a top-quality NEC Multisync II monitor and an exceptionally fast disk-drive controller for an impressive combination of value and performance ... From a vendor with an increasing reputation for quality." (Feb. 28, 1989)

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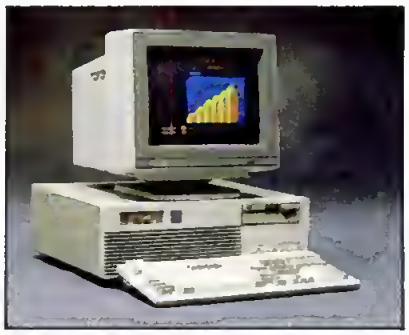

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JS EDITOR'S CHOICE SOFTWARE

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TATUNG COMPANY OF AMERICA INC.

TATUNG TCS-8000

At first glance, the $3,995 base price of the 20-MHz Tatung TCS-8000 seems high for a unit equipped with only an average list of components. The standard complement of 1MB of RAM, 1.2MB floppy disk drive, Western Digital controller, parallel and serial ports, keyboard, and DOS 3.3 with GW-BASIC won't excite any feature seekers out there.

The high price is partially explained when you take a closer look at the components. The RAM chips are rated at a speedy 80 nanoseconds, and the Delta power supply is 210 watts strong.

Further explanation of the hefty price tag resides in the quality of construction. This 54-pound heavyweight was originally designed for the Taiwanese military, and it's built to take a licking. All the machines are burned in for 72 hours in a room heated to over 100 degrees Fahrenheit. The chassis itself is an extra-heavy-duty case; there are even mounting screws on the bottom so that you can attach it to your *jeep*. If you need a rugged system that will withstand extreme conditions in less than desirable locations, the price begins to look less extravagant.

The $7,885 demo machine that we received housed a 155MB Priam hard disk. Priam models are known for their reliability, further bolstering the company's commitment to producing a ready-to-rough-it machine. The system also included 2MB

The Tatung TCS-8000 is a 54-pound fighter; its heavy-duty case and 72-hour burn-in time in a room heated to over 100 degrees Fahrenheit are meant to prepare it for extreme conditions. Surprisingly, though, the keyboard is not particularly suited to rough environments.

HARD DISK SPEED: THE CACHE ADVANTAGE

You say that you've got a fast 386 chip and a speedy RAM cache, but your hard disk is holding things up by reading and writing at a sluggish pace? If that's the case, you may want to invest in one of the high-speed hard disk caching controllers that are just beginning to show up on the market.

These controllers first came to our attention while we were running disk benchmark tests on some of the 386 machines reviewed here. Especially on the small-record DOS File Access test, we noticed that the Bus machines' scores just blew away the competition, and the VIPC models were also among the top performers. Opening the computers revealed the source of this speedy performance: the Bus machines were equipped with Distributed Processing Technology's DPT Caching Disk Controller, and the VIPC systems used Konan Corp.'s TenTime controller. While there are functional and technical differences between the two devices, the bottom line is that these controllers can make your computer scream, even if you don't have a 386. And if you do, well, just make sure your heart can stand a trip into hyperspeed.

THE CACHE CONNECTION If your everyday computer tasks involve processing transactions or running compilers, or if in any way they are heavily oriented toward hard disk access, intelligent caching controllers can be a godsend.

The DPT hard disk controller just blew away the competition.

The common thread that ties these controllers together is the presence of on-board memory chips used for Read/Write caching. Read caching means that the controller keeps in its own memory the last bunch of information it found on a drive; the quantity of information depends on the amount of memory available for the Read cache. Data still in the cache is accessible almost instantly, without taking up normal RAM.

Write caching covers the other part of what controllers do—putting information back on the drive. The information to be refiled is held in the Write cache, allowing the computer's processor and normal RAM memory to go about their next tasks. Depending on software and circuitry, the controller puts the information back when the computer is less busy, when a set amount of time has passed, or when the Write cache gets so full that the only alternative would be to throw the information away.

Having a caching controller is like having two secretaries assisting you while you search for information in a filing cabinet. One secretary holds onto the

of RAM and a 16-bit VGA adapter and Tatung VGA monitor. Somewhat surprisingly, the Tatung keyboard is of the standard variety—it is not specially designed to withstand shock, extreme temperature, or any other hazards of unfriendly environments.

The clock speed is switchable between 20 and 8 MHz, and the bus runs at a true 8-MHz speed for maximum compatibility.

The Tatung unit offers five half-height drives—three accessible and two internal. The eight expansion slots on the Tatung motherboard are divided into six 16-bit and two 8-bit configurations. The motherboard does not incorporate any 32-bit slots but can hold up to 16MB of 32-bit RAM itself.

FAST RAM, LOW SCORES The fast 80-ns. RAM chips allow the system to operate at zero wait states without cache. (Of course, the bad news is that memory upgrades will cost more.) Even with the fast RAM chips, the lack of any RAM shadowing or other schemes to perk up the system resulted in less-than-impressive benchmark test scores, especially in PC Labs' processor and memory tests.

Tatung informed us that the machine has a newly acquired FCC Class B rating, although there was no sticker to indicate this rating on the system; nor is it likely that most home users would need to purchase such a rugged machine, especially considering the cheaper alternatives on the market. Tatung also told us that it is planning to push the system to the corporate marketplace, although the design of the machine (except for the keyboard) makes it seem as if the wiser move would be to target it for industrial applications.

If you are looking for lowest price or highest performance, keep looking. If you need a solidly built machine that can take an unusually punishing environment, however, the Tatung could be for you. **—Kate Emery**

PC MAGAZINE FACT FILE

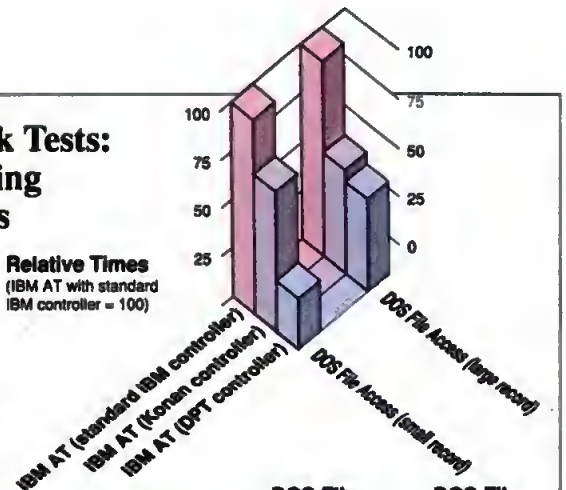
Tatung TCS-8000
Tatung Company of America Inc.
2850 El Presidio St.
Long Beach, CA 90810
(800) 421-2929
(213) 979-7055
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, DOS 3.3, $3,995; with 40MB hard disk, monochrome monitor, $5,610; with VGA monitor, $6,440; with 2MB RAM, 155MB hard disk, $7,885. 1MB RAM upgrade, $595.
In Short: The Tatung TCS-8000 is an average 20-MHz machine, with average performance, at an average price of $3,995. However, this unit stands out if you need a rugged system that may need to withstand a less-than-agreeable environment, such as a shop floor. The stable, 54-pound machine was originally designed by Tatung for the Taiwanese military.

CIRCLE 886 ON READER SERVICE CARD

PC LABS

Benchmark Tests: Disk Caching Controllers

On the DOS File Access tests, when compared with IBM's controller, the two disk caching controllers chopped 28 percent and 74 percent off the performance time for small records and cut 46 percent and 52 percent off the time for large records.



Performance Times (Times given in seconds except where noted)	DOS File Access (small record)	DOS File Access (large record)
IBM AT (standard IBM controller)	73.10	18.91
IBM AT (Konan controller)	52.73	10.19
IBM AT (DPT controller)	19.00	9.04

files that have just been looked at in case they are needed again soon, and the other puts files away if they are not asked for within a certain amount of time. This leaves you free to examine and reexamine the information without wasting time relocating it or putting it away. The "intelligent" aspect of these caching controllers is that they combine the two "secretarial" functions using the same memory, and they do it all without your giving them instructions.

DRAMATIC IMPROVEMENTS Our curiosity about the DPT and TenTime controllers led us to request sample units and test them in an 8-MHz IBM PC AT. We ran our normal disk benchmark tests, using first the original IBM AT controller and then the DPT and Konan units.

The differences were dramatic. On the DOS File Access tests, when compared with IBM's controller, the two caches chopped 28 percent and 74 percent off the performance time for small

(continues)

TELEVIDEO SYSTEMS INC.
TELOAS III 386/16

Televideo Systems, the well-known video terminal manufacturer, has seen some hard times due to the DRAM chip shortage and other factors unrelated to the quality of its products. Key to the company's rebound may be the success of its TelOAS product line—a full set of 8088-, 80286-, and 80386-based systems. Sold custom-configured through largely OEM channels since their debut in 1987, these systems can be purchased through distributors.

The TelOAS (Televideo Open Architecture System) III 386/16 proves itself a reliable performer while breaking no speed records. The $3,599 list price for the base system—1MB RAM, 1.2MB floppy disk drive, one parallel and two serial ports—is high but can reportedly be discounted as much as 35 percent by distributors, bringing it down to a more palatable $2,339.

With the 12-slot version of Televideo Systems' TelOAS III 386/16, you can install four full-length cards after adding a system board, extended memory card, controller, and video. You can leave the left three half-height bays free to squeeze in three more full-length cards.

Our tested configuration, with 4MB RAM, 40MB hard disk, VGA card and monitor, and DOS, runs to $7,675 before any discount.

A LOOK INSIDE The zero-wait-state TelOAS follows the familiar practice of mounting a system board, containing the 16-MHz processor, onto a passive backplane design. Besides the processor (switchable to 8 MHz with software) and a slot for an 80387 coprocessor, the system board holds a neatly packed VLSI chip set from Chips and Technologies, a lithium clock/calendar battery, and the I/O ports.

The first four SIMM banks of 256-kilobit, 100-nanosecond DRAMs (1MB chips may also be used) also go onto the 16-bit system board, and 12 additional memory banks fit into a separate but adjacent board. The two are attached with a proprietary 32-bit connector.

This layout offers the advantage of upgradability: should you decide to move up

"Hard Disk Speed" (continued)

records, and cut 46 percent and 52 percent off the time for large records.

Our DOS File Access tests contain several parts. The Konan board, with 128K of cache memory, performed best on small and sequential records and was actually slower than the AT controller on a few of the test's large random reading and writing tasks. But the DPT board showed a significant improvement over the AT controller across all aspects of the DOS File Access test, including both large and small records and sequential and random read and write operations.

MORE DIFFERENCES Our test results tell only part of the story. DPT's $1,150 controller comes standard with 512K of cache memory, expandable to 16MB. The controller's speed is affected by the processor's speed—it runs faster on faster computers. The unit has the advantage of being register-compatible with the Western Digital controller, which means you're ready to go as soon as you take out the standard controller and pop the DPT into your AT-bus 386s and AT-compatibles. The DPT works with ST-506 MFM (Modified Frequency Modulation) drives, but the company makes a whole line of controllers for many other types of drives.

The downside of all this is that DPT's unit uses volatile memory. If you turn the machine off or if the system hangs before the contents of the cache are written back to the drive, you can lose all the information.

Konan's $695 TenTime controller has only 128K of memory, but the use of a lithium battery (good for 4 years) means that the RAM used is nonvolatile. With nonvolatile memory, if the machine is turned off or hangs before information is written back to the drive, the information is maintained on the cache board until the computer is turned on again—up to 4 years later, theoretically. When eventually the power is restored, the board simply puts the information back where it belongs.

The Konan board is less dependent on processor speed, taking advantage of faster buses to increase the speed of read and write operations. Konan's board works on 386 AT-bus machines and AT compatibles with ST-506 MFM hard disks. For $745, you can get a Konan board that works with RLL (Run Length

PC MAGAZINE FACT FILE

DPT Caching Disk Controller
Distributed Processing Technology
132 Candace Dr.
P.O. Box 1864
Maitland, FL 32751
(407) 830-5522
List Price: $1,150
Requires: Any 286- or 386-based AT-compatible system with a hard disk.
CIRCLE 670 ON READER SERVICE CARD

TenTime
Konan Corp.
1829 W. Drake Dr., #103
Tempe, AZ 85283
(602) 345-1300
List Price: For MFM drives, $695; for RLL drives, $745.
Requires: Any 286- or 386-based AT-compatible system with an ST-506 hard disk.
CIRCLE 671 ON READER SERVICE CARD

FACT FILE

TelOAS III 386/16
TeleVideo Systems Inc
550 E. Brokaw Rd.
P.O. Box 49048
San Jose, CA 95161-9048
(408) 954-8333
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, $3,599; with 40MB hard disk, monochrome monitor, DOS 3.3, $4,674; with VGA color monitor, $4,875; with 4MB RAM, $7,675. 1MB RAM upgrade, $699.
In Short: The TelOAS III 386/16 offers easy upgrading through its plethora of slots in a passive backplane design, though it fared no better than average on PC Labs processor and memory benchmark tests. Sold custom-configured largely through OEM chennels, this reliable performer is also available at substantial discounts from national distributors.

CIRCLE **635** ON READER SERVICE CARD

Limited) drives. These boards can replace the standard controller, but you need to use the special software provided to reformat and partition the hard disk drives first.

The Konan and DPT prices are not just pocket change. But these controllers offer clear advantages, and they'll more than make up their cost for anyone dealing with transaction-oriented applications or any process where the machine spends a good deal of time retrieving information and then putting it away. An additional advantage: both of these boards are reasonably easy to install, and they come with surprisingly clear and complete documentation.

Like memory and video caches, the new drive controller caches continue the tradition of improving performance beyond processor and memory speed and RAM-capacity increases. Right now, drive cache controllers are not very common and are still rather expensive. But as their benefits become more widely realized, we can expect to see them showing up more often, especially in high-performance machines.—**Bruce Brown**

to a 486 processor in the future, it's a simple matter (however costly) to switch boards. But there's a hitch: expansion boards inherently suffer more wear and tear to their exposed contacts than do independent motherboards.

The 12-slot version of the TelOAS (4- and 8-slot systems are options) allows installation of one half-length and four full-length cards after adding in a system board, extended memory card, disk controller, and 16-bit video adapter. If you leave the left halves of your six half-height drive bays free, you can squeeze in three more full-length cards; these slots are half-length otherwise. A 240-watt power supply made by Televideo has connectors for four devices and a user-replaceable fuse that comes in handy in case of overload.

NO SPEED DEMON Televideo's 32-bit system/memory board connection apparently proved insufficient when it came to PC Labs' Extended Memory test—the TelOAS scored near the bottom of the heap. Ditto for the small-record portion of the DOS File Access test, which taxed the machine's Western Digital ST-506 controller beyond its ability to shine.

Elsewhere, the TelOAS performed nearly dead center: no speed demon, but no slouch. On its side is sturdy construction, good design, helpful documentation, and quick setup and configuration.

The TelOAS proved no speed demon—but no slouch, either.

Televideo intends its TelOAS line to address needs as diverse as standalone applications, LANs, and engineering workstations for either DOS or Unix. For its price and power, it faces an uphill climb to rival the competition. But if your priority is less blinding speed than easy upgrading, take a look at the TelOAS III 386/16.
—**Edward L. Perratore**

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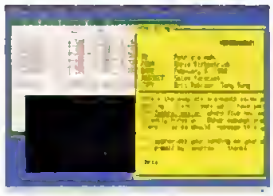

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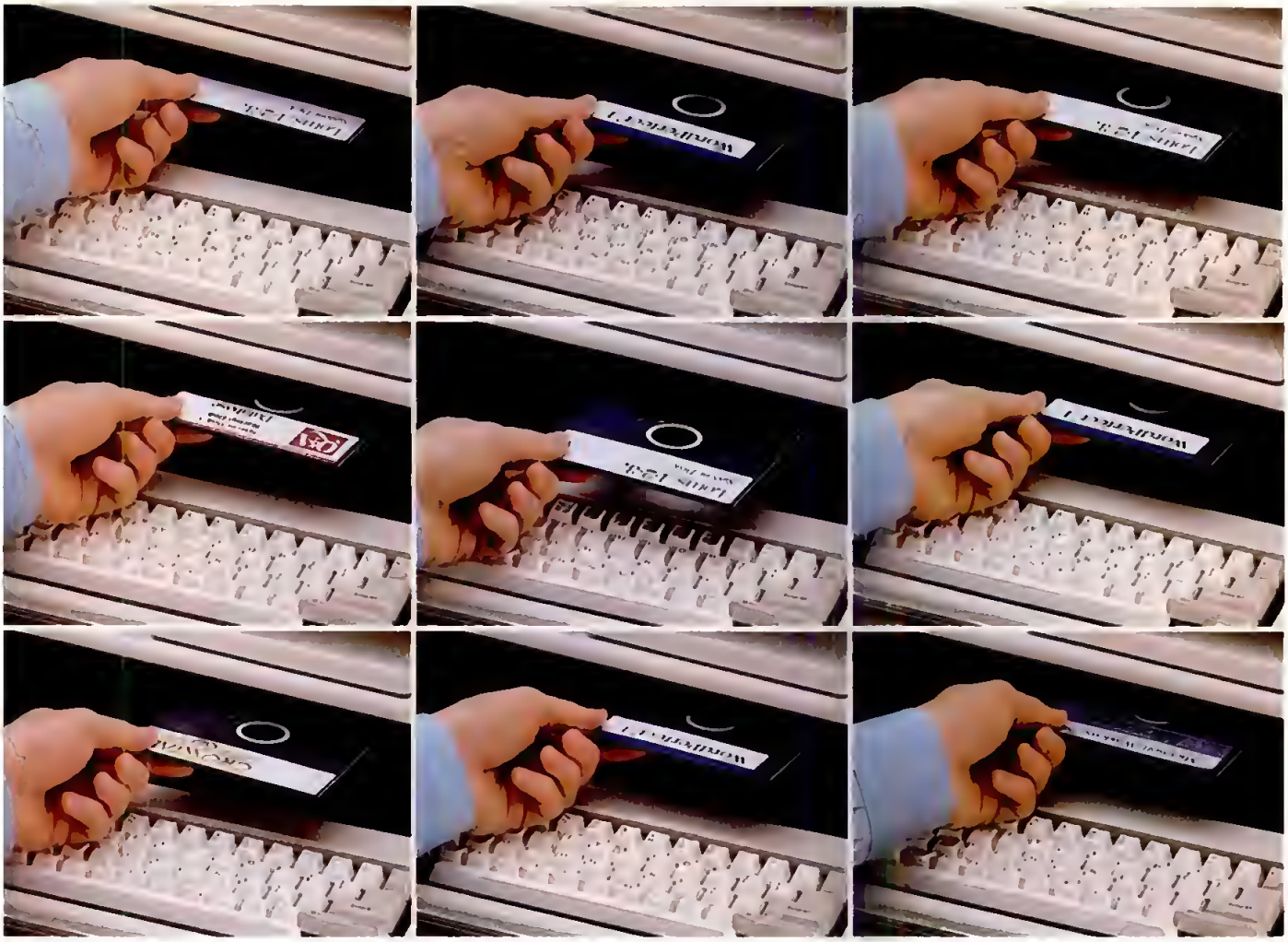

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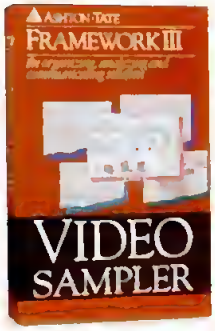

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This chart compares the results of ***PC Magazine Laboratories*** *"File Access Speed Benchmark Test" BENCH23 - version 3.0 transfering 64 records of 4KB each with* HYPERDISK *(in black) and without it (in red).*

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CIRCLE 328 ON READER SERVICE CARD

TUSSEY COMPUTER PRODUCTS LTD.
SWAN 386/16
SWAN 386/20D

There's no mistaking the marketing strategy behind Tussey Computer Products' Swan 386/16 and Swan 386/20D. The 16- and 20-MHz systems, base priced at $1,999 and $2,199, are geared to attract the attention of anyone who wants 386 performance on a budget. In both cases, the base price includes 1MB RAM, one floppy disk drive, and a keyboard.

From the outside, the two machines look identical. The standard AT-clone cases house a 1.2MB, 5¼-inch floppy disk drive and offer access to three half-height disk drive bays. From the back, you can see the two serial ports and the single parallel and game ports that come with each unit. The $3,533 and $4,818 test configurations came with Hi-Tek Enhanced-style 101-key keyboards and Magnavox VGA monitors.

UNDER THE HOOD Pull off the covers, and the similarities between the two machines continue. Both offer the same beefy, 200-watt power supply, and both use an 8-bit VGA adapter from a little-known company called Cirrus. The units rely on the Phoenix ROM BIOS, which includes a handy setup program.

Even the manuals are almost identical; they are also of a much higher quality than you might expect with bargain-priced systems. Although they do not have anything so extravagant as an index, information is

Tussey Computer Products' Swan 386/20D (like the company's 386/16) is packaged in a standard AT-clone case. The Twinhead motherboard doesn't accept RAM but supports a 32-bit memory card (with a limited capacity of 8MB) in one of its eight slots.

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PC MAGAZINE FACT FILE

Tussey Computer Products Ltd.
P.O. Box 1006
State College, PA 16804
(800) 468-9044
(814) 234-2236

Swan 386/20D
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, $2,199; with 80MB hard disk, monochrome monitor, DOS 3.3, $3,138; with VGA monitor, $3,637; with 2MB RAM, 150MB hard disk, $4,818. 1MB RAM upgrade, $436; 40MB tape backup, $299.

CIRCLE 666 ON READER SERVICE CARD

Swan 386/16
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, $1,999; with 80MB hard disk, monochrome monitor, DOS 3.3, $2,938; with VGA monitor, $3,437; with 2MB RAM, 40MB hard disk, $3,533. 1MB RAM upgrade, $396; 40MB tape backup, $299.

CIRCLE 667 ON READER SERVICE CARD

In Short: Less-than-stellar performance offsets the low, low prices offered by the Tussey Computer Products' 386 machines. If you can accept slower performance and some less-than-well-known components, you will find an opportunity to save some dollars with these machines.

presented in a clear and accessible manner—almost a rarity these days.

The only major differences between the two models are in the CPUs (of course) and the hard disk drives. The 20-MHz test machine had a 150MB CDC hard disk attached to an Adaptec hard/floppy disk controller. The 16-MHz version came with a 40MB Seagate driven by a combination hard/floppy disk controller from the not widely known National Computer.

MEMORY LIMITS Each system uses the same Twinhead motherboard, which sports eight slots: one proprietary 32-bit, three 8-bit, and four 16-bit. Since the motherboard doesn't accept any RAM, the single 32-bit slot comes complete with a memory card. Both the 16- and 20-MHz review machines had 2MB worth of 256-kilobit chips installed on the card.

Unfortunately, the card only has a 32-bit memory capacity of 8MB. With the growing pressure to expand operating system and application memory requirements, the 8MB limit may become constraining in the coming years.

Of course, chances are that the machines' audience of budget-minded buyers won't even make use of the maximum 8MB, at least not in the immediate future. But long-term considerations require that you keep this limitation in mind when shopping around, especially in light of the predicted drop in memory prices. You don't want to bump up against the 8MB limit and be forced to replace the entire system before its 3- to 5-year life span is complete.

There is one more unfortunate feature shared by these two computers: neither fared particularly well in our benchmark tests. Without design refinements like a hardware memory cache, the systems' overall processing performance suffered when compared to other computers in their respective classes.

To give these machines their due, adequate construction and a fair complement of mainstream components give them credibility, and their rock-bottom price tags certainly command attention. If you are willing to sacrifice some speed and risk living with the memory limitations, they represent bargain values in the 386 arena.
—Alfred Poor

UNIQ TECH INC.
UTI 386/20

There's nothing terribly unique about the UTI 386/20, but this is no criticism. It's just an acknowledgment of Uniq Tech's use of solid, brand-name components in its 20-MHz machine—a factor that should appeal to buyers looking for a ride on the safe side. The machine does, however, have some limitations that could make it the wrong choice for anyone with above-average expectations.

The desktop-size system we received included a host of well-known parts, including a Paradise 16-bit VGA card and NEC MultiSync II monitor, a generous 250-watt power supply from PC Power and Cooling, floppy disk drives from TEAC (1.44MB) and Mitsumi (1.2 MB),

Uniq Tech's UTI 386/20 uses the standard complement of solid, brand-name components to enhance reliability. The total of seven expansion slots can be a real limitation, though, as can the 8MB memory capacity of the system.

a Seagate 80MB hard disk, a Chips and Technologies chip set, and the Orchid Privilege-386 card, at a cost of $3,975. The price of the base system, which includes a monochrome monitor and Hercules graphics card, 1MB of RAM, and a 220-watt power supply, logs in at a low $1,699.

The system also includes Mitsumi's 101-key keyboard. It's got a soft feel—no clickiness, but good response just the same. The front panel contains most of the increasingly standard features, including power-on, turbo mode, and hard disk access LEDs, as well as a reset button and key lock.

TO THE HEART The heart of the machine is the 32-bit Privilege-386 card, which houses the Intel 80386 CPU and the AMI BIOS. The 386 chip is lodged awkwardly beneath a daughtercard that contains the four-pin turbo light connector, but ordinarily this wouldn't be a problem. You may have trouble, however, if you have to slide the full-length card, encumbered by its protuberant appendage, between the white plastic edge guides located at the front panel end of each slot.

While the Orchid card has the space to accommodate an 80387 or Weitek 1167

PC MAGAZINE FACT FILE

UTI 386/20
Uniq Tech Inc.
3640 Westchase Dr.
Houston, TX 77042
(713) 780-7170
(800) 237-4961
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, $1,699; with 60MB hard disk, monochrome monitor, DOS 3.3, $2,187; with VGA color monitor, $2,866; with 80MB hard disk, 1.2MB 5¼-inch and 1.44MB 3½-inch floppy disk drives, $3,205. 1MB RAM upgrade, $400; 60MB tape backup, $549.
In Short: The UTI 386/20 is a solid, if not innovative, system built on brand-name components. While it may appeal to users with average needs, an 8MB 32-bit memory limitation, less than lightning speed, and skimpy slot space make it a poor choice for those with more extensive requirements.
CIRCLE 659 ON READER SERVICE CARD

coprocessor, it doesn't support any memory chips. The 2MB of 80-nanosecond DRAM that came with our unit were clustered in eight 256-kilobit SIMM packs located unusually close to the power supply on the backplane board. You can upgrade the memory to 8MB by substituting 1-megabit chips, but even that substantial amount of 32-bit memory seems small when compared to the 16MB (or higher) memory capacity of some other systems.

The system is also short on port options and slot space. Even in the test configuration, no serial or parallel port was included, and only seven slots were available—one 32-bit, four 16-bit, and two 8-bit. A serial/parallel device connector located behind the memory chips could help you save slot space, but according to the company, it's presently a useless option as the cost of activating it exceeds the purchase price of an I/O card.

You can run the machine at full speed or use Orchid's utility software to throttle down to 5, 6.7, or 8 MHz. The bus can be shifted among 10-, 6.7-, 5-, or 8-MHz speeds; that's a pretty reasonable compromise between the slow-going, octogenarian boards of yesterday and the quicker youngsters of today.

Speed is helped by relocating video and BIOS ROM into 384K of shadow RAM and running the machine at zero wait states. Our benchmark tests, however, showed the system's CPU speed to be at the lower end of 20-MHz performance; partial compensation for this is made by the quick, 28-millisecond hard disk.

If you don't have big expansion plans and can live without blinding speed and masses of memory, this system's relatively low price and standard components from reputable companies could make it worth your while.—**Jennifer Zaino**

VIPC COMPUTERS CORP.
VIPC 386/16
VIPC 386/20
VIPC 386/25

VIPC, a Hayward, California, mail-order firm, gives you a real choice when it comes to purchasing a 386 PC: you can have the company build a machine just for you, incorporating your specifications onto a motherboard it selects for optimum performance, or you can choose one of its preconfigured 386 systems—either the basic unit or a fully loaded model. VIPC's 386/16 is base priced at $1,499; base prices for the 20- and 25-MHz versions are $1,999 and $2,999, respectively.

Those basic prices include 1MB of RAM, a 1.2MB 5¼-inch floppy disk drive, a 230-watt power supply, and a parallel port. The 20-MHz version comes with an EGA adapter built into the motherboard, but no monitor.

Phoenix BIOS chips are found on the Micronics motherboards in the 16- and 25-MHz units. The 20-MHz model sports an AMR motherboard and the Quadtel BIOS.

Software-controllable shadow RAM to improve video and system performance is available on all units. Zero-wait-state memory is standard on the 16- and 20-MHz machines, while the three-wait-state 386/25 uses the Intel 82385 cache controller, with 64K of 35-nanosecond cache memory, to achieve greater speed.

For the base prices, a desktop configuration is standard. Our preconfigured test units, however, came in an optional $300 tower-style case.

You can choose either a Maxi-Switch, Key Tronic, or Nan Tan 101-key keyboard. I prefer the clickier Nan Tan model, though others might like the relatively soft feel of the Key Tronic or the middle-of-the-road Maxi-Switch.

The test units also had three performance-enhancing options: heavy-duty power supplies, fast VGA video cards, and a fancy hard disk controller. The power supplies are rated at 375/450 watts, more than needed for the units as configured, and sufficient to handle all of the RAM and add-ons you can squeeze into the case.

The three machines used Video Seven V-RAM VGA cards; the cards included a chip that lets the computer continue processing as data is transferred to the screen. We had to disable the standard EGA port on the 20-MHz version to use the card; it seemed wasteful, but the resulting video performance made it worthwhile.

The Konan TenTime Intelligent Caching hard disk controller has a 128K cache that can speed up disk access incredibly. For anyone who runs applications that are heavily disk read/write intensive, this $695 option is a godsend. If your average record size is less than 64K, the Konan controller

The VIPC 386/25, the leader of a family of three 386-based PCs, is basically an adequate performer, although it is distinguished mostly by the Konan Tentime hard disk drive controller. A 128K cache, a fast VGA card, and a heavy duty power supply are more salient features.

QNX vs. OS/2 UNIX

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ARCHITECTURE If the micro world were not so varied, QNX would not be so successful. After all, it is the operating system which enhances or limits the potential capabilities of applications. QNX owes its success (over 75,000 systems sold since 1982) to the tremendous power and flexibility provided by its modular architecture.

Based on message-passing, QNX is radically more innovative than UNIX or OS/2. Written by a small team of dedicated designers, it provides a fully integrated multi-user, multi-tasking, networked operating system in a lean 148K. By comparison, both OS/2 and UNIX, written by many hands, are huge and cumbersome. Both are examples of a monolithic operating system design fashionable over 20 years ago.

MULTI-USER OS/2 is multi-tasking but NOT multi-user. For OS/2, this inherent deficiency is a serious handicap for terminal and remote access. QNX is both multi-tasking AND multi-user, allowing up to 32 terminals and modems to connect to any computer.

INTEGRATED NETWORKING Neither UNIX nor OS/2 can provide integrated networking. With truly distributed processing and resource sharing, QNX makes all resources (processors, disks, printers and modems anywhere on the network) available to any user. Systems may be single computers, or, by simply adding micros without changes to user software, they can grow to large transparent multiprocessor environments. QNX is the mainframe you build micro by micro.

PC's, AT's and PS/2's OS/2 and UNIX severely restrict hardware that can be used: you must replace all your PC's with AT's. In contrast, QNX runs superbly on PC's and literally soars on AT's and PS/2's. You can run your unmodified QNX applications on any mix of machines, either standalone or in a QNX local area network, in real mode on PC's or in protected mode on AT's. Only QNX lets you run multi-user/multi-tasking with networking on all classes of machines.

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lets you save time by giving control back to the processor while it writes information to the hard disk on its own. In case you turn off the computer during this process, the lithium battery on the controller enables the cache to remember what was being written for the next time you power up.

VIPC 386/16 The 16-MHz VIPC test unit has a list price of $5,999. Besides most of the base system components and the options listed above, this unit included a Seagate ST-4053 44MB 28-millisecond hard disk, a 1.44MB 3½-inch second floppy disk drive, and a NEC MultiSync II monitor.

The Micronics 16-MHz motherboard featured zero-wait-state static-column RAM and a 32-bit memory expansion slot. Software lets you lower the processor speed to 4.77, 6, or 8 MHz, but the expansion bus speed stays at a safe 8 MHz.

The test machine, which came with 4MB of 80-ns. memory on the 32-bit card, was one of the fastest performers in its class.

VIPC 386/20 Besides the basics, our test 20-MHz unit came with a Seagate 80MB 28-ms. hard disk and a Sony Trinitron multiscan display. The extra goodies brought the price up to $6,999.

The 20-MHz system boasts an AMR motherboard with several built-in ports—two serial and two parallel—a floppy disk controller, and the aforementioned EGA controller. The motherboard held the maximum 2MB of 80-ns. DRAM memory, but a proprietary AMR 32-bit slot can handle an expansion card with 16MB more.

CPU speed is selectable between 20 MHz and 8 MHz. The machine runs at zero wait states, but if you need to slow things down a bit, the setup program lets you switch easily to one wait state. No memory caching is available, but the four-way page-mode interleaving helps in performance.

Even so, the 20-MHz version was one of the lower scorers on the processor and memory benchmark tests. Where it did well was on on the drive and video tests.

VIPC 386/25 The 25-MHz machine we received came with a Maxtor 160MB 23-ms. hard disk, 80387 25-MHz coprocessor, Sony Trinitron monitor, 3½-inch 1.44MB second floppy disk drive, TEAC 60MB streaming-tape backup device, and 8MB of 100-ns. DRAM, list priced at a towering $12,499. (VIPC adjusts the price of its machines according to the current market prices for RAM chips, good news if the predicted drop in memory chip prices occurs.)

The motherboard includes one 32-bit memory expansion slot that can take up to 16MB of RAM. The bus speed is switchable between 8.33 and 12.5 MHz. The slower 8.33 speed might be the best bet now, when most expansion cards need 10 MHz or less, but you'll be glad of the 12.5-MHz option when faster boards become available. While the machine operates at either three or four wait states and uses only 100-ns. chips, the 82385 cache controller helps to make up the difference.

In general, the PC Labs benchmark tests showed the system to be an adequate performer. It received its highest marks in the BIOS Disk Seek tests, but it was considerably slower in the DOS Disk Access category. Its marks on the memory speed tests were a bit low, too.

The only drawback with the VIPC machines was a tendency for expansion cards to come loose during shipping. The tower case must be a little too roomy for the full-length cards. Once everything was seated properly, the machines ran just fine.

VIPC offers a 1-year warranty on parts and labor; if service is required, the company generously pays shipping both ways. The downside is that VPIC does not include an on-site service contract during the first year.

Even in their dressed-to-kill test configurations, these machines' prices compare favorably with other vendors' systems. When you factor in the quality components, you realize that VIPC can become an aggressive presence in the 386 market.
—Bruce Brown

PC MAGAZINE FACT FILE

VIPC Computers Corp.
384 Jackson, # 1
Hayward, CA 94544
(415) 881-1772
(800) 222-5657

VIPC 386/16
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, $1,499; with 60MB hard disk, monochrome monitor, DOS 3.3, $2,099; with VGA color monitor, $2,499; with 4MB RAM, 44MB hard disk, tower case, $3,499. 1MB RAM upgrade, $350; 60MB tape backup, $499.
CIRCLE 663 ON READER SERVICE CARD

VIPC 386/20
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, $1,999; with 60MB hard disk, monochrome monitor, DOS 3.3, $2,599; with VGA color monitor, $2,999; with 4MB RAM, 80MB hard disk, tower case, $4,199. 1MB RAM upgrade, $350; 60MB tape backup, $499.
CIRCLE 664 ON READER SERVICE CARD

VIPC 386/25
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, $2,999; with 60MB drive, monochrome monitor, DOS 3.3, $3,599; with VGA color monitor, $3,999; with 8MB RAM, 155MB hard disk, 60MB tape backup, 1.2MB 5¼-inch and 1.44MB 3½-inch floppy disk drives, 80387-25 coprocessor, tower case, $6,999. 1MB RAM upgrade, $350; 60MB tape backup, $499.
CIRCLE 665 ON READER SERVICE CARD

In Short: VIPC makes a noticeable splash with these three 386 computers. Each machine is a considered blend of components, chosen to achieve the greatest performance possible.

VNS AMERICA CORP.
SIVA AT386

Here's a price leader that demands consideration. For a base price of $1,845, VNS America's 20-MHz SIVA AT386 comes standard with 1MB of 100-nanosecond RAM, a 1.2MB 5¼-inch floppy disk drive with a combination hard/floppy disk controller, one parallel and two serial ports, a monochrome monitor, and a Fujitsu keyboard with good tactile response. But that's not all: the price includes a 40MB hard disk and a 200-watt power supply packaged inside an attractive tower-style case. The real kicker is that if you buy $3,200 of Unix software from VNS America, the company will give you this base system for *free*.

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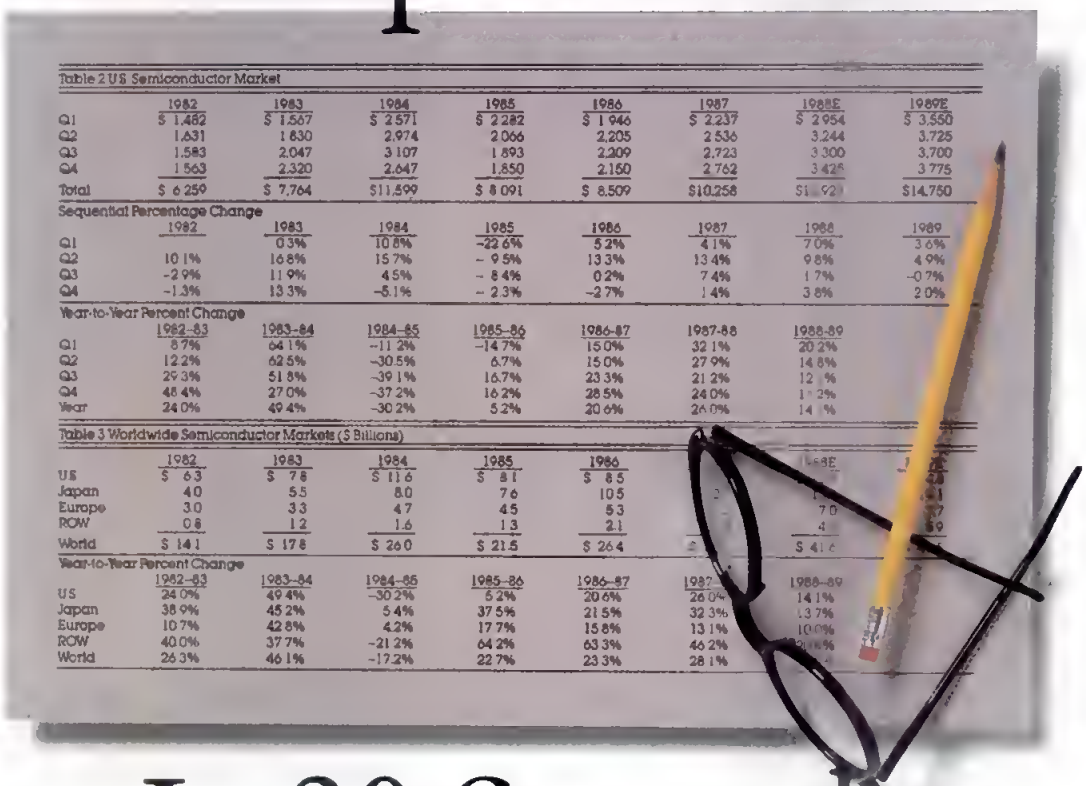

Table 2 US Semiconductor Market

	1982	1983	1984	1985	1986	1987	1988E	1989E
Q1	$ 1,482	$ 1,567	$ 2,571	$ 2,282	$ 1,946	$ 2,237	$ 2,954	$ 3,550
Q2	1,631	1,830	2,974	2,066	2,205	2,536	3,244	3,725
Q3	1,583	2,047	3,107	1,893	2,209	2,723	3,300	3,700
Q4	1,563	2,320	2,647	1,850	2,150	2,762	3,425	3,775
Total	$ 6,259	$ 7,764	$11,599	$ 8,091	$ 8,509	$10,258	$12,923	$14,750

Sequential Percentage Change

	1982	1983	1984	1985	1986	1987	1988	1989
Q1		0.3%	10.8%	-22.6%	5.2%	4.1%	7.0%	3.6%
Q2	10.1%	16.8%	15.7%	- 9.5%	13.3%	13.4%	9.8%	4.9%
Q3	-2.9%	11.9%	4.5%	- 8.4%	0.2%	7.4%	1.7%	-0.7%
Q4	-1.3%	13.3%	-5.1%	- 2.3%	-2.7%	1.4%	3.8%	2.0%

Year-to-Year Percent Change

	1982-83	1983-84	1984-85	1985-86	1986-87	1987-88	1988-89
Q1	5.7%	64.1%	-11.2%	-14.7%	15.0%	32.1%	20.2%
Q2	12.2%	62.5%	-30.5%	6.7%	15.0%	27.9%	14.8%
Q3	29.3%	51.8%	-39.1%	16.7%	23.3%	21.2%	12.1%
Q4	48.4%	27.0%	-37.2%	16.2%	28.5%	24.0%	11.2%
Year	24.0%	49.4%	-30.2%	5.2%	20.6%	26.0%	14.1%

Table 3 Worldwide Semiconductor Markets ($ Billions)

	1982	1983	1984	1985	1986	1988E	1989E
US	$ 6.3	$ 7.8	$ 11.6	$ 8.1	$ 8.5		
Japan	4.0	5.5	8.0	7.6	10.5		
Europe	3.0	3.3	4.7	4.5	5.3	7.0	
ROW	0.8	1.2	1.6	1.3	2.1	4	
World	$ 14.1	$ 17.8	$ 26.0	$ 21.5	$ 26.4	$ 41.6	

Year-to-Year Percent Change

	1982-83	1983-84	1984-85	1985-86	1986-87	1987	1988-89
US	24.0%	49.4%	-30.2%	5.2%	20.6%	26.0%	14.1%
Japan	38.9%	45.2%	5.4%	37.5%	21.5%	32.3%	13.7%
Europe	10.7%	42.8%	4.2%	17.7%	15.8%	13.1%	10.0%
ROW	40.0%	37.7%	-21.2%	64.2%	63.3%	46.2%	
World	26.3%	46.1%	-17.2%	22.7%	23.3%	28.1%	

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2500 Augustine Drive, Santa Clara, CA, USA 95054

CIRCLE 144 ON READER SERVICE CARD

Even after enhancing the test configuration with 4MB of RAM, a 16-bit Paradise VGA card, a Packard Bell VGA monitor, a second floppy disk drive, a math coprocessor, and an 80MB hard drive, the price rose only to $5,134.

The SIVA motherboard has an Intel 80386 20-MHz processor that you can set back to 16 MHz or even 8 MHz for fussy software. The programmable expansion bus controller is independent of the system-memory access timing, so you can set the bus to run at a conservative 8-MHz or increase its speed to 10-MHz if your cards can handle it.

The motherboard uses a Chips and Technologies VLSI 386 chip set and comes with the AMI 386 BIOS. These standard and highly compatible brands speak well for the system's design and underscore the value you get at a very low price.

You can put up to 8MB of RAM on the motherboard before you need to add a memory expansion card to reach the system maximum of 16MB of 32-bit memory. (VNS currently charges $430 for each megabyte of 100-ns. static-column DRAM chips.) The SIVA AT386 uses memory interleaving and shadows both video and ROM BIOS. There is no cache memory, which can account for the predominantly average scores it received on our benchmark tests.

In addition to the single 32-bit memory expansion slot, there are two 8-bit slots and five 16-bit expansion slots. In a space pinch, the 32-bit slot can take 16-bit cards.

VNS America's low-priced, 20-MHz SIVA AT386 makes an excellent file server. The tower case sits on a wide-based stand for stability and can fit six half-height storage devices with exposed fronts. The 8-MHz bus speed option forces finicky network cards to behave.

FACT FILE

SIVA AT386
VNS America Corp.
910 Boston Post Rd., #270
Marlboro, MA 01752
(800) 252-4212
(508) 481-7192
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, $1,845; with 40MB hard disk, monochrome monitor, DOS 3.3, $2,195; with VGA monitor, $2,690; with 4MB RAM, 80MB hard disk, 1.2MB 5¼-inch and 1.44MB 3½-inch floppy disk drive, 80387-20 coprocessor, $4,895.
In Short: This is a clone 20-MHz system with very good parts and an excellent price. For $2,460 you'll get a 40MB drive and a monochrome monitor. The pricing is exceedingly attractive, the only fly in the soup being a lack of FCC approval at the time of testing.
CIRCLE 660 ON READER SERVICE CARD

ROOM TO GROW The tower case sits on a wide-based stand for stability and can hold six half-height storage devices, all with exposed fronts. The power supply has only four device connectors, so you'll need a pair of splitters if you fill the box up with drives.

The storage potential of this system makes it a good choice for anyone with high-powered computing needs, and an especially good file-server candidate. The 8-MHz bus speed option means you won't have to worry about its rejecting picky network cards.

These computers are sold via mail order, and all service is performed at the company's Massachusetts facility. The standard 1-year warranty includes one-way shipping for minor service work, but VNS America will pay both ways if a problem results from a major system defect.

It's when you run across a 386 system like this one, packed with good features and components for a very low price, that you have to wonder why anyone would even consider buying a 286 machine.
—Bruce Brown

WANG LABORATORIES INC.
WANG 381
WANG 382

Wang Laboratories is well known for helping to make word processing an essential part of the modern office, and its minicomputers are in use worldwide. But until now, Wang hasn't been broadly successful in the MS-DOS microcomputer market. Part of the reason is that although the first Wang PCs were MS-DOS compatible, you had to go through arcane machinations to reach that state. Even Wang's first 80386 machine, a truly MS-DOS-compatible unit designed and built largely by Intel, didn't give Wang the boost it needed to achieve broad-based success in the microcomputer arena.

The introduction of the Wang 381 and 382 386 systems, base priced at $2,900 and $3,155, respectively, may change all that. Designed from the ground up by Wang, these machines beautifully tread that fine line between mainstream me-too banality and over-the-edge eccentric uniqueness.

The only significant difference between the 381 and the 382 is their CPU clock speeds: the 381 is a 16-MHz machine, while the 382 runs at 20 MHz. Otherwise, inside and out, they are almost identical.

The power switches sit in an accessible position on each model's handsome front panels. Three half-height drive bays on the right of each machine can be reached through openings in the front panel. Inside, you will find another full-height drive bay that exhibits one of the few flaws in the machine's physical design: it has only rail slots at the bottom, hence it cannot be used for two half-height devices. This is just a small drawback, however.

QUALITY CONSTRUCTION Every other aspect of these machines displays an

MUTOH

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Pencil plotting is beautiful. It produces clear, sharp lines that make perfect copies, even with low-cost systems. When beauty is more than what meets the eye, you'll also find that pencil can be cleanly erased and redrawn in last-second upsets.

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continued on following page

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5 OPEN SLOTS	4 OPEN SLOTS	5 OPEN SLOTS	8 OPEN SLOTS	8 OPEN SLOTS
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continued from previous page

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enviable high-quality design and construction. The cases are made of a substantial grade of steel, helping the units to outweigh their lightweight competition. A steel rod serves as a cross brace, joining the front and rear panels right at the middle of the chassis. The drive bays are made of heavy-gauge metal, adding strength to shielding.

So that you won't have to slide the cover on and off, as you must with a typical cheap case, the Wangs' covers have three "fingers" on each edge that slip into slots in the chassis. This arrangement lets you lift the top off easily after you slide it for a few inches; it also makes the top stay on securely when put back into place. The screws that hold the case together are "captive" on the back panel; you cannot drop them or lose them as you might on most other machines.

As for the electronics, Wang designed its own motherboard, but built it with standard components. The company uses the Chips and Technologies chip set and the Phoenix ROM BIOS. The motherboard includes one parallel, one serial, and one mouse port.

The motherboard doesn't accept any memory; instead, a 32-bit card can boost maximum memory to 16MB, using 1-megabit SIMMs.

The 20-MHZ Wang 382 displays quality construction at every turn, including an extra-sturdy steel case, drive bays of heavy-gauge metal, easy-to-remove tops, a proprietary motherboard that features standard components, and a remarkably responsive keyboard.

Every detail appears to be engineered beyond minimum requirements, which should make the machines more reliable and solid. For example, the 381 runs at 16 MHz but uses Chips and Technologies components rated for 20-MHz operation. The 382 runs at 20 MHz but uses chips rated at 25 MHz.

OUTSTANDING FEATURE The tested configurations ($6,595 for the 16-MHz unit, $7,895 for the 20-MHz model) each came with a Wang monitor, a VGA adapter using Tseng Labs VLSI chips, a hard disk (42MB in the 381, 68MB in the 382), and a keyboard.

The latter is perhaps the systems' strongest feature. Built by Honeywell for Wang, the keyboard follows the standard 101-key layout. Simply put, it has one of the nicest touches of any keyboard I have ever used, including IBM's PS/2 keyboard. It also has an internal key click that you can make louder or softer by using a keystroke combination.

Both computers turned in respectable, but not stellar, performance times on our benchmark tests, in part because neither offers hardware memory caching. Interleaved memory, however, does help boost performance a bit.

While the prices of the fully configured Wang 381 and Wang 382 won't win prizes as low-cost bargains, they are not unreasonable when compared with other top brands such as IBM, Compaq, Tandy, or AT&T. If you are looking for a solid machine that is built well and backed by a major manufacturer, either of these Wang models deserves consideration.

—Alfred Poor

FACT FILE

Wang Laboratories Inc.
55 Technology Dr.
Lowell, MA 01851
(800) 962-4727

Wang 381
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, $2,900; with 68MB hard disk, VGA monochrome monitor, DOS 3.3, $6,210; with VGA monitor, $6,640; with 2MB RAM, 42MB hard disk, 1.2MB 5¼-inch and 1.44MB 3½-inch floppy disk drives, $6,595. 1MB RAM upgrade, $675; 60MB tape backup, $1,800.

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Wang 382
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, $3,155; with 68MB hard disk, VGA monochrome monitor, DOS 3.3, $6,445; with VGA monitor $6,875; with 2MB RAM, 42MB hard disk, 1.2MB 5¼-inch and 1.44MB 3½-inch floppy disk drives, $6,795. 1MB RAM upgrade, $675; 60MB tape backup, $1,800.

CIRCLE 662 ON READER SERVICE CARD

In Short: The Wang 381 and 382 are good-looking, well designed, and solidly built. They use high-quality components and do an excellent job of presenting an original design that is compatible with the mainstream market.

WYSE TECHNOLOGY
WYSE pc386

Like other PCs from Wyse Technology, the 16-MHz Wyse pc386 uses modular system architecture; the idea is to "plug-and-play" your desired configuration as processor upgrades become available. Although the modular approach never really caught on, Wyse's pc386 offers first-rate features and performance. For $3,599, you get a base configuration including 1MB RAM, 1.2MB 5¼-inch drive, and DOS 3.3.

On the outside, the pc386 can pass for an average PC clone. At power-up, the 16-character LCD window on the front panel displays the time and processor speed. The two buttons below the window allow you to switch between the default display, the percent of CPU usage, and system diagnostics. A third button on the front panel toggles the processor between 16 and 8 MHz.

When you look inside, you'll first notice the perfectly usual four drive bays accessible from the front and the fifth, half-height bay located under the two rightmost drives. What will get your attention is the absence of a base-plane motherboard, although there are plenty of expansion slots: 11 in all (hence the modular architecture).

At the heart of the modular design are two full-length boards containing the 80386 processor, a coprocessor socket, the Phoenix BIOS, and the discrete motherboard components. In our test system, which was equipped with 4MB of RAM, all system memory was on proprietary memory boards that flanked the system boards on either side. (The base price includes only one memory board with 1MB of RAM and room for another 1MB of 256K chips.) To assure 32-bit memory access, the tops of these boards have a 32-bit edge connector; a top-planar bridge connects the memory boards.

Up to three memory boards containing 2MB each can be installed in the machine. An additional 10MB of memory can be added using commercial memory boards, although the additional RAM will be accessed at the 8-MHz bus speed.

ZERO-WAIT-STATE PROCESSING Wyse's use of page-mode memory assures zero-wait-state processing in systems with 1MB of RAM or less. If the memory exceeds 1MB, a two-way interleaving scheme takes over to achieve zero wait states. In the memory benchmark tests, the pc386 scored in the top half of the 16-MHz machines.

The 16-MHz Wyse pc386's modular architecture consists of two 32-bit boards holding the CPU, a coprocessor socket, the BIOS, and discrete motherboard components. The maximum 6MB of 32-bit RAM is achieved via three 16-bit memory boards with 32-bit edge connectors.

FACT FILE

Wyse pc386
Wyse Technology
3571 N. 1st St.
San Jose, CA 95134
(800) 438-9973
(408) 433-1000

List Price: With 1MB RAM, 1.2MB floppy disk drive, DOS 3.3, $3,599; with 85MB hard disk, monochrome monitor, $7,563; with VGA monitor, $8,267; with 4MB RAM, 85MB hard disk, 60MB tape backup, $11,849. 1MB RAM upgrade, $649.

In Short: The Wyse pc386 rates up with the other top performers among 16-MHz machines. But while Wyse continues to use its modular design, being able to plug in a faster processor card hasn't caught on as a low-cost upgrade path. Equipped with a fast Hitachi hard disk and an easy-to-use tape backup system, this unit comes fully configured out of the box; the only strike against the pc386 is its stiff price tag.

CIRCLE 398 ON READER SERVICE CARD

At first, 11 expansion slots seem like a lot, but they do fill up quickly. In the test unit, the two 32-bit slots contained the system boards, and EGA and I/O cards took up two of the three 8-bit slots. Four of the six 16-bit slots were filled by the two 2MB memory boards, a Wangtek tape drive controller, and a Western Digital ESDI drive controller.

The unit we received also included a Wyse EGA monitor, an 85MB Hitachi hard disk, and the SY-TOS operating system for the Wangtek tape backup unit. Other extras are DOS 3.3, a LIM 3.2 emulator, and a Wyse disk-caching program. All told, the unit came to $11,849.

The pc386 is full of the features you'd expect in a 386 PC, and it even outperforms some of the more expensive machines in its class. Wyse is standing behind its modular architecture and plans to ship a 25-MHz model by the time you read this. On the downside, Wyse has recently cut its workforce by 15 percent to cope with the crumbling market share of its 286 PC line. The only thing to watch out for is whether Wyse Technology can hold its own against the current onslaught of manufacturers with lower-priced, feature-filled 386s.—**Greg Alwang**

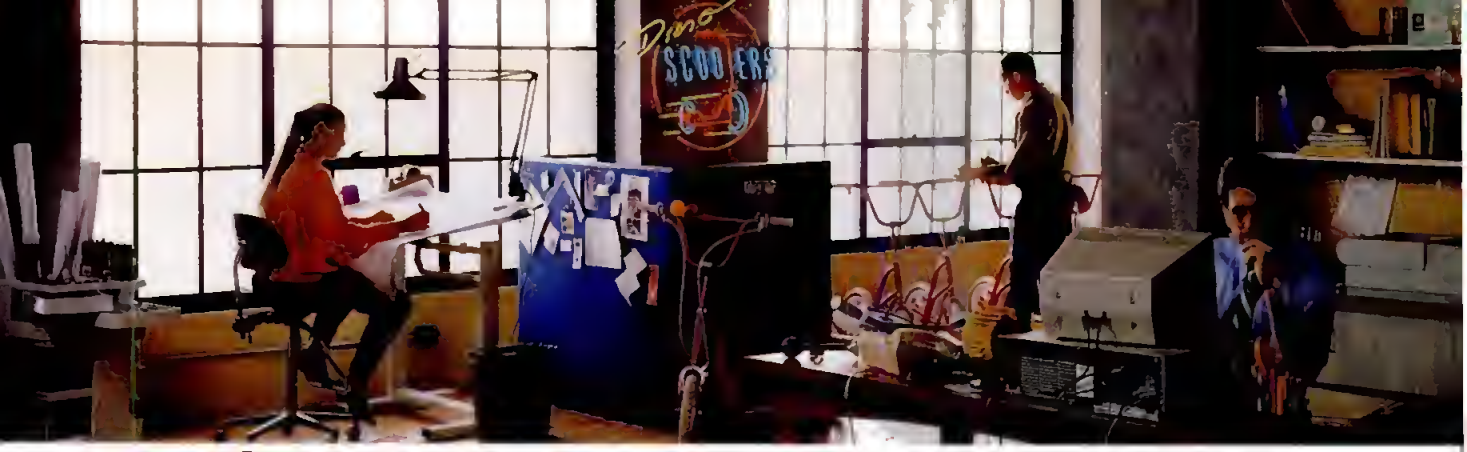
ZENITH DATA SYSTEMS
ZENITH Z-386/25

Zenith's engineers pulled out all the stops to wring performance from its flagship model, the Zenith Z-386/25. This is a zero-wait-state, 25-MHz machine with 64K of 25-nanosecond cache memory and Zenith's oddly named Slushware, which automatically shadows video and ROM BIOS into faster system RAM. The $6,599 base system also plays host to Zenith's unique Superset intelligent bus architecture, which detects the speed of each interface card at bootup and runs the individual slot speeds accordingly—anything from 4.77 MHz for an 8-bit card to 25 MHz for a 32-bit card.

With all of these enhancements, the Zenith entry falls well within the performance range of the other 25-MHz machines we tested, although it does not qualify as one of the fastest in its class.

THE PRICE OF POWER As with many 25-MHz systems, performance doesn't come cheap. The Zenith base configuration alone is quite pricey, consider-

The unique Superset intelligent bus architecture is a feature of the Zenith Z-386/25. It detects the speed of each interface card at boot-up and runs the individual slot speeds accordingly, from 4.77 MHz for an 8-bit card to 25 MHz for a 32-bit board.



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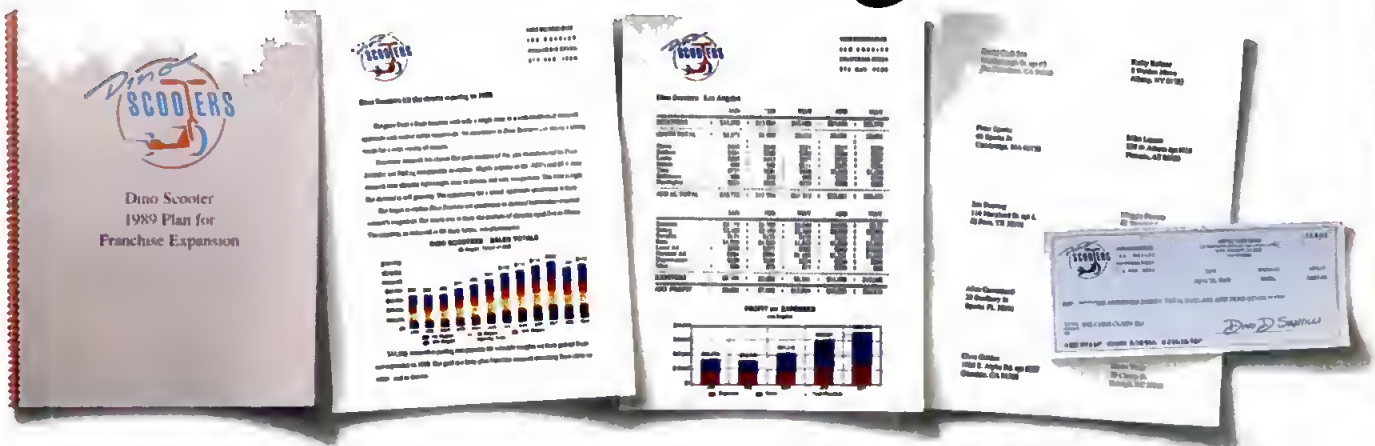

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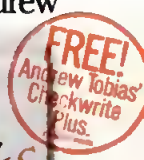

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■ 80386 DESKTOP PCs

PC MAGAZINE FACT FILE

Zenith Z-386/25
Zenith Data Systems
1000 Milwaukee Ave.
Glenview, IL 60025
(800) 842-9000
(312) 699-4800
List Price: With 2MB RAM, 1.44MB 3½-inch floppy disk drive, DOS 3.3, $6,599; with 70MB hard disk, VGA monochrome monitor, $9,298; with VGA monitor, $9,698. with 150MB hard disk, $10,298; 1MB RAM upgrade, $799.
In Short: This machine offers a 25-MHz processor, an intelligent I/O bus, and RAM shadowing in an impressive and fairly priced machine. Zenith will never be known for cut-rate goods, but compared with IBM and Compaq, its prices are competitive. Team this machine with a Zenith flat-screen monitor and smile as you fly.

CIRCLE 666 ON READER SERVICE CARD

ing that it includes only 2MB of memory and no hard disk or monitor. The tested unit, with the standard 2MB of RAM, 155MB CDC hard disk, DTC controller, and Zenith's flat-screen monitor, lists for a hefty $10,298. Luckily, Zenith machines are often discounted aggressively, both individually by dealers and in group contract purchases.

The full-sized desktop case can hold only four half-height drives. The limitation isn't so damaging considering that one of the drives can be a full-height 320MB model. The 200-watt power supply has four connectors for the storage devices and is aided by two system fans to keep it cool inside.

There are four 32-bit and three 16-bit full-length expansion slots. (Eight-bit cards will work in the 16-bit slots.) With the standard complement of one parallel and one serial port, 16-bit VGA card, and hard/floppy disk controller, four slots are free.

The motherboard can take up to 8MB directly. An additional 24MB can be added using 32-bit expansion cards, for a 32-bit system maximum of 32MB of RAM. The motherboard also has sockets for the 80387 and Weitek math coprocessors.

Zenith supplies this machine with *Microsoft Windows/386* and an enhanced version of MS-DOS 3.3. Like DOS 4.0, Zenith's DOS 3.3 Plus can work with drive partitions greater than 32MB. Zenith's implementation, however, stores drive table information in an unusual location. The result is that some standard drive or directory maintenance and utility programs just won't work.

ADDED EXTRAS We tested the Z-386/25 with Zenith's gorgeous high resolution VGA flat-screen monitor. You may not notice much difference if you're working only in monochrome applications, but for anything that uses color, the Zenith flat screen goes beyond eye-catching.

A big plus is Zenith's nationwide network of authorized dealers. It's nice to be assured of having a place to take your computer should it need service.

Teamed with the fast and beautiful flat-screen monitor, the Z-386/25 makes a terrific tool, especially for CAD and desktop publishing applications where both speed and display quality are terribly important. If you can get one at a good price and don't care about the nonstandard way it stores drive information, this is a machine that should keep you happy for some years to come.—**Bruce Brown**

ZEOS INTERNATIONAL LTD.

ZEOS 386-16
ZEOS 386-20
ZEOS 386-25

The Zeos International line of zero-wait-state 386 computers—the 386-16, 386-20, and the 386-25—are a quality alternative to higher-priced 386 systems. Backed by a 1-year parts and labor warranty, these speedy, well-built machines offer value to cost-conscious buyers. And a no-questions-asked, 30-day money-back guarantee helps ease apprehensions of potential purchasers.

Zeos is in the process of furthering its commitment to customer support by establishing a relationship with a nationwide service organization. It soon expects to furnish on-site service during the 1-year warranty period and to offer optional extended coverage as well. In its eighth year

in operation, Zeos seems to be striving to become a very serious contender in the clone market.

The base prices of the 16-, 20- and 25-MHz machines ($1,945, $2,545, and $3,545, respectively) all include 1MB RAM and a floppy disk drive, as well as parallel and serial ports. In addition, Zeos also offers plenty of customization options. Each model, for instance, may be configured with a variety of hard disks, disk controllers, video cards and displays, floppy disk drives, RAM configurations, and motherboard options.

You can even have Zeos house your custom configuration within a small (XT-sized) desktop, a medium (AT-sized) desktop, or a tower case. Though the small case may be appealing for its eight full-sized expansion slots and space-saving styling, prospective buyers should note that there is only enough room to accommodate three internal half-height drives and/or tape backup devices. Compare that with the AT- and tower-sized systems, which can house at least four drive or tape devices.

Given all the flexibility to mix and match cases and components among the three basic product lines, the primary feature that distinguishes these machines is, naturally, speed. The Zeos 386s' overall performance compared favorably to the rest of the machines we reviewed, ranking near the top on the all-important 80386 Instruction Mix test. Here's how they matched against each other: using a composite of overall processor and memory access speed, the 20-MHz unit outperformed the 16-MHz model by approximately 25 percent. The difference was less dramatic, but still evident, between the two faster machines, with the 25-MHz model taking a 15 percent lead over the speed of the 20-MHz unit.

ZEOS 386-16 The small-case unit we tested included a compact, pristine VLSI American Megatrends motherboard with 64K static RAM cache memory, a 16-MHz Intel microprocessor, and the AMI Mark II 386 BIOS. Two megabytes of RAM were loaded onto an accompanying 32-bit expansion card. An Adaptec floppy and a standard-issue MFM hard disk controller, a Paradise Professional VGA card, and a serial/parallel card filled three of the system's six 16-bit slots. With a 40MB Seagate hard disk, Tatung VGA color monitor, and DOS 3.3, the entire system retails for $3,838.

Because of the compact style of the motherboard, the small-case systems offer the least opportunity for memory expansion. But at a practical system maximum of 8MB of 32-bit RAM, using 1-megabit

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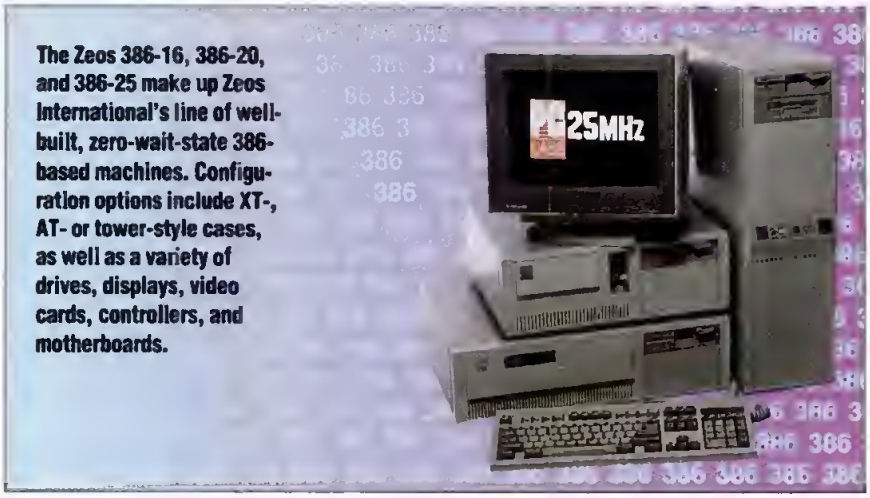

The Zeos 386-16, 386-20, and 386-25 make up Zeos International's line of well-built, zero-wait-state 386-based machines. Configuration options include XT-, AT- or tower-style cases, as well as a variety of drives, displays, video cards, controllers, and motherboards.

chips on both the expansion card and a piggyback board, in addition to a theoretical limit of 64MB using 4Mb chips, this restrictiveness is not likely to cause inconvenience for a large segment of users right now. Those who think they'll need at least 16MB (using 1Mb chips), however, should look elsewhere.

ZEOS 386-20 This AT-sized desktop unit was configured with an American Megatrends motherboard with 2MB dynamic RAM, 64K static RAM cache memory, the 20-MHz Intel microprocessor and AMI BIOS. An Adaptec floppy and RLL 1:1 interleave hard disk controller, Video Seven 16-bit V-RAM VGA card with 256K cache, and one serial and one parallel port were also included. Equipped with a 65MB 28-millisecond Seagate hard disk, DOS 3.3, and a Tatung VGA monitor, this peppy system sells for a relatively inexpensive $4,483.

As with the other Zeos machines reviewed, you get eight full-sized expansion slots (one 8-bit, six 16-bit and one 32-bit); the 32-bit slot can double as an 8-bit slot if required.

The 64K static RAM cache (which is upgradable to 128K) is also included in the standard configuration of each Zeos system. In addition, the machines operate at zero wait states, so shadow RAM and memory interleaving features are not enabled in the default configurations in order to bolster performance. However, there are specific video operations, such as CAD/CAM applications, that would be greatly enhanced by the use of shadow RAM; in cases such as these, the user would be wise to enable that facility with the setup disk.

ZEOS 386-25 A physically attractive powerhouse, the 25-MHz tower came equipped with 4MB of dynamic RAM, one serial and one parallel port, Seagate 65MB 28-ms. hard disk, and 1.2- and 1.44MB floppy disk drives powered by a Data Processing Technology RLL floppy/hard disk controller with 512K cache. As in the other systems, the company uses an American Megatrends motherboard with 64K memory cache and the AMI Mark II BIOS. The video setup mirrored that of the 20-MHz system. Together with DOS 3.3, this workhorse 386 retails for a pretty modest $7,037.

One interesting design element found on the full-sized motherboards in the 25- and 20-MHz test units is the ability to accept both socketed DIP RAM and strip, or SIMMs, at the same time in 256-kilobit, 1Mb, or 4Mb chips; using the last would bring the motherboard capacity to a whopping 32MB of 32-bit RAM. Using 4Mb chips, the 32-bit expansion card and piggyback board each have capacities equal to that. Since the price, availability, and integrity of 4Mb chips are not yet assured, you'll have to be satisfied with the 24MB you can get by using 1Mb chips on the motherboard and on expansion and piggyback boards.

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CIRCLE 188 ON READER SERVICE CARD

EDITOR'S CHOICE

- **DataWorld Data 386-20 and 386-25**
- **Dell System 310**
- **IBM PS/2 Model 70-A21**
- **Micro 1 Power 386-16**
- **Northgate Elegance 386/20 and Elegance 386/25**

When it comes to 80386-based PCs, what makes a PC Magazine *Editor's Choice? Price is always a consideration. So are benchmark test results. But both factors can be deceiving, which is why we consider them in the context of other aspects that will make the difference months and years down the road. Things like quality of construction, reliability, expandability, and ease of service.*

Out of 104 machines from 58 companies, we chose 10 that offer the most from the PC buyer's wish list—machines that vary in size, price, and even bus architecture. Two MCA machines are included; no machines using the competing EISA bus were released in time for this issue.

For overall excellence in both the 16- and 20-MHz categories, we selected Zeos International's **386-16** *and* **386-20**. *Besides scoring impressive overall results on the PC Labs benchmark tests, these machines offer plenty of customization options, high-quality parts, and 64K static-RAM cache memory. The small-case 386-16 costs $3,293 for a VGA system with 1MB RAM, a 65MB hard disk, and one 5¼-inch floppy disk drive. The AT-size 386-20 ($3,788 in a similar configuration) provides the additional attraction of software-setable shadow RAM. There's more: Zeos adds a 30-day money-back guarantee, with no questions asked to its 1-year warranty service.*

Also chosen was the **Micro 1 Power 386-16**. *At $2,550 (with 1MB RAM, 60MB hard disk, 5¼-inch floppy disk drive, and VGA monitor), this machine is a find for users who aren't bothered by the lack of good documentation. Its low price portends no sacrifice in performance. Also on its side are expandability to 16MB RAM, high-quality parts, and plenty of hard-disk options.*

We picked four 20-MHz machines besides the Zeos. One strong showing is the **Dell System 310** *($4,299 with 1MB RAM, 40MB hard disk, 5¼-inch floppy disk drive, and VGA monitor); this system best represents the mail-order firm's determination to stand up to the big guys. The System 310 uses the page-mode and interleaving functions of its Chips and Technologies chip set to whiz through most of its tests; brand-name parts and shadow RAM help, too.*

DataWorld's **Data 386-20** *and* **Data 386-25** *stand out in the 20- and 25-MHz categories for speed and quality construction. The minitower Data 386-20 (at $3,893 for 1MB RAM, 66MB hard disk, 5¼-inch floppy disk drive, and VGA monitor) and the Data 386-25 ($1,000 more for a similarly configured system) both merit consideration.*

If the **Tandy 5000MC** *is any indication of a Micro Channel future, then Micro Channel architecture is sure to grow in popularity. This machine's wealth of expansion options—with three I/O ports, floppy disk controller, and VGA running off the motherboard—add to the appeal of its impressive showing on PC Labs' benchmark tests. A VGA system with 2MB RAM, 70MB hard disk, and 3½-inch floppy disk drive costs $7,498. An added benefit of this machine over IBM's PS/2 Model 70s is that Tandy has left room for an internal 5¼-inch floppy disk drive.*

Our last Editor's Choice in the 20-MHz category is the **Northgate Elegance 386/20** *from Northgate Computer Systems—whose sturdy tower model, the* **Northgate Elegance 386/25**, *is a winner among the 25-MHz systems for its file-server potential. These machines sell for $4,024 and $4,624 respectively, with 1MB RAM, 68MB hard disk, two floppy disk drives, and VGA monitor. These prices include high-quality components, superior documentation, top-flight performance, a grab bag of helpful utilities like the* Super PC-Kwik *disk manager and caching software, and other thoughtful measures. Another plus is that within the first year of purchase, Northgate will overnight-ship any replacement part without making you first ship back the defective unit.*

Out of 104 machines from 58 vendors, we chose 10 that offer the most from a PC buyer's wish list.

Just one caveat: True to its nature as an innovator, Northgate continually upgrades its systems. Most changes should be for the better, but before you order you should

- **Tandy 5000MC**
- **Zeos 386-16 and 386-20**

be sure to double-check the configuration.

Also in the 25-MHz category is one company that pulls together all it's got to present a powerhouse machine: Big Blue. Although one more expansion slot would improve it even more, IBM's ***Model 70-A21*** *beats most of its competition in benchmark tests, thanks largely to 64K of cache memory and a different motherboard than the 16- and 20-MHz Model 70s use. As expected, this MCA machine does not come cheap; the price is $12,195 for a VGA system with 2MB RAM, 120MB hard disk, and 3½-inch floppy disk drive. But it deserves special attention—more than the Model 70-E61 and -121 and the floor-standing Model 80s do.*

Long after we finished our benchmark testing, we learned that IBM had temporarily stopped shipping its Model 70-A21 because of what the company claimed were engineering problems in the motherboard. Regardless of these difficulties, PC Magazine *stands by its choice of the 70-A21 as a superior machine. We're confident that any changes made have been improvements—and whatever else one can say about IBM, it does not strand customers.*

Honorable mention *goes to Everex Computer Systems for its Step 386/16, 386/20, and 386/25. All three systems use a proprietary BIOS; since reliable alternatives exist from companies like Phoenix and Award, a proprietary BIOS not only differentiates the product line but adds uncertainty.*

With all these systems to choose from, it's natural to look for corners to cut. Be careful, though, to avoid snipping in places you'll regret later. For overall excellence and bang for the buck, we contend that a 20 MHz system is the best way to go. But if your needs take you into file servers, CADD, high-end graphics, software development, or artificial intelligence, consider a 25 MHz machine instead. For about one-third more money, this will offer the performance necessary for specialized applications. (See the sidebar "Buying Smart: The Right System for Your Needs.")

Keep in mind that every 386 machine deserves a VGA or Super VGA monitor rather than an EGA. If you're cost-constrained, buy a monochrome VGA system rather than a Hercules-compatible system; monochrome VGA uses the same adapter as color, making for an easy upgrade later. And don't short-change yourself on disk capacity. While a 386-16 can often get away with a 40MB ST-506 hard disk, with 20- and 25-MHz systems it's best to consider a faster ESDI drive of 90MB and up.

A word on behalf of the 386s we didn't select for Editor's Choice. We at PC Magazine *are the first to say that 386 technology represents the cutting edge of personal and workgroup computing. And undoubtedly there's no clear demarcation between the winners and a dozen runners-up. Not being chosen is no mark of shame; those we selected simply offer an outstanding combination of factors that make for a top-quality machine. Among the unchosen are several models from large companies like Compaq, Hewlett-Packard, and Zenith—plus Advanced Logic Research (ALR), which received PC Magazine's Award for Technical Excellence last November.*

Compaq, the sales leader of 386-based computers, sells machines that are rugged, dependable high-performers. Nevertheless, these machines achieved only average scores on our benchmark tests. They remain expensive, both for standard configurations and for upgrades, and they offer no tower unit that can be used as a multidrive file server; instead you must buy an expansion box. With the ever-increasing number of competent 386 vendors putting together top-notch computers for fewer dollars, it's getting tougher and tougher to justify a high-end PC purchase. Still, no one ever got fired for buying Compaq.

ALR has come down a peg over time. Several units we tested over an extended period (and others we bought) exhibited quality-control problems—nothing that couldn't be fixed with more attention to detail on ALR's part, but enough to raise eyebrows at PC Labs.

With its Z-386/25, Zenith (a favorite of the federal government) scored poorly in benchmark tests despite such enhancements as shadow RAM, 64K of cache memory, and the ability to set slot speeds individually. Its high-resolution flat screen monitor is gorgeous, but the computer's base configuration is pricey.

Likewise, the Hewlett-Packard 386 line exhibits quality workmanship, performance, and dependability. But its top-dollar prices, which aren't discounted as heavily as Tandy's, kept the HPs from being selected for an Editor's Choice—this time. Keep an eye on this company.

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■ 80386 DESKTOP PCs

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EDITOR'S CHOICE

Zeos 386-16
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, $1,945; with 65MB hard disk, monochrome monitor, DOS 3.3, $2,598; with VGA monitor, $3,293; with 2MB RAM, 40MB hard disk, $3,764. 1MB RAM upgrade, $495; 115MB hard disk, $450; 60MB tape backup, $398.

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EDITOR'S CHOICE

Zeos 386-20
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, $2,545; with 65MB hard disk, monochrome monitor, DOS 3.3, $3,093; with VGA monitor, $3,788; with 2MB RAM, $4,483. 1MB RAM upgrade, $495; 115MB hard disk, $300; 60MB tape backup, $398.

CIRCLE **668** ON READER SERVICE CARD

Zeos 386-25
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, tower case, $3,545; with 65MB hard disk, monochrome monitor, DOS 3.3, $4,093; with VGA monitor, $4,788; with 4MB RAM, 1.2MB 5¼-inch and 1.44MB 3½-inch floppy disk drives, $7,037. 1MB RAM upgrade, $495; 115MB hard disk, $300; 60MB tape backup, $398.

CIRCLE **689** ON READER SERVICE CARD

In Short: The Zeos 386 line offers a full complement of eight expansion slots with room for three half-height media devices at very competitive prices. The workhorse in this round-up, the Zeos 386-25, is a powerful and attractive machine that any user with truly demanding performance requirements can't afford to overlook.

ucts that Zeos should consider upgrading: the documentation. Since each system from Zeos is practically custom-built, this would be undeniably complicated. Zeos, however, claims to have just created its own systems documentation and should be shipping it soon.

Overall, Zeos appears to have the staying power and the proper balance in its product/pricing/technical and service matrix to compete successfully in this formidable market segment.—**Stephen Lewiski and Philip J. LaRussa** PC

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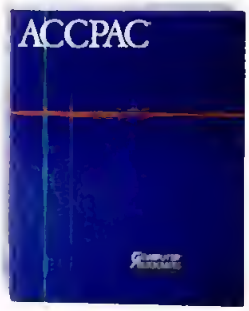

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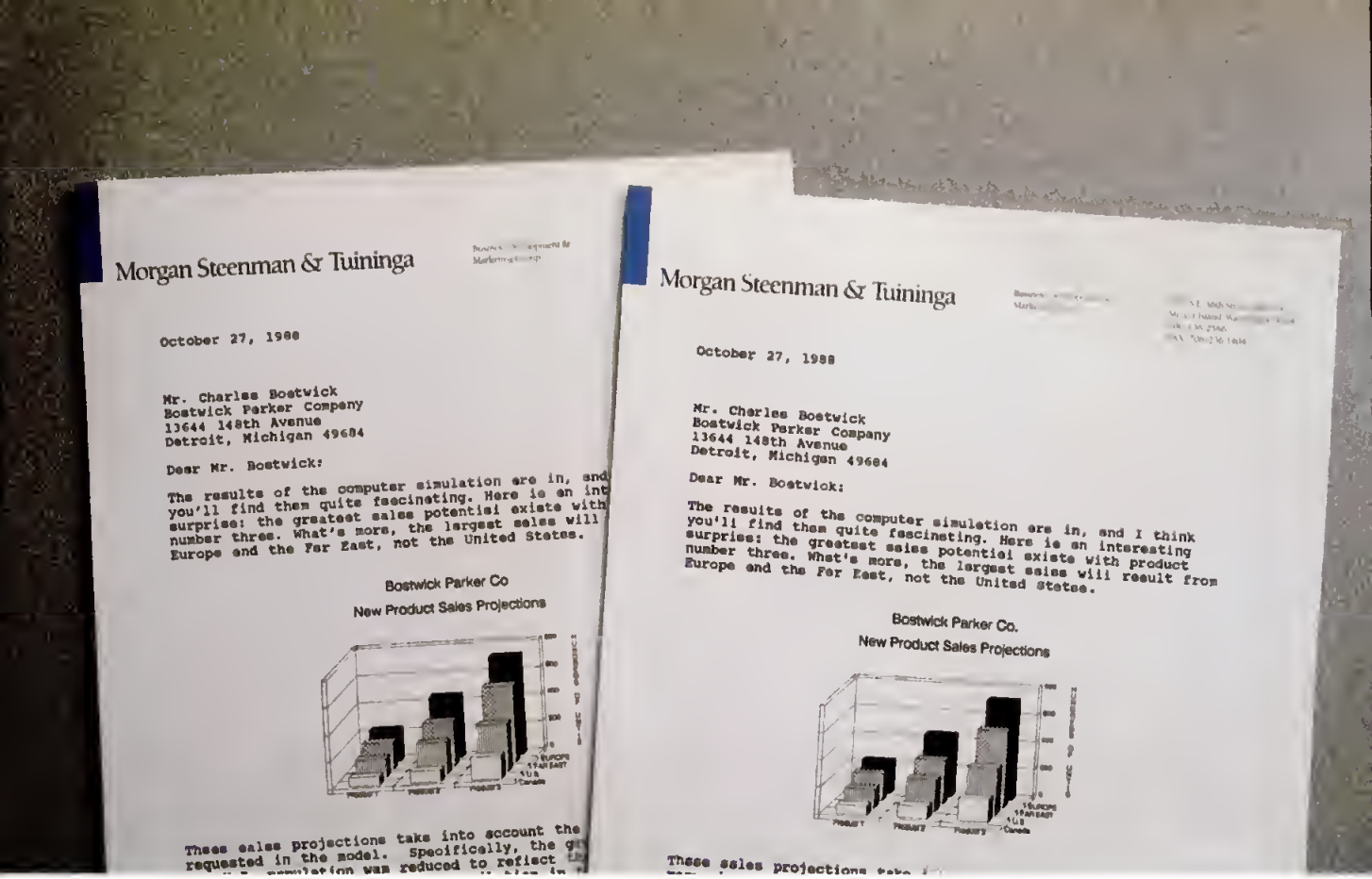

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PC MAGAZINE

PRODUCTIVITY

■ PC LAB NOTES ■ WINN L. ROSCH

MULTITASKING WITHOUT OS/2

Both Microsoft Windows/386 and DESQview 386 give your 386 machine multitasking capabilities with today's DOS applications. Here's how to optimize their performance.

Someday we may all be able to take advantage of the multitasking capabilities of OS/2—but work can't always wait for someday. That's why *Microsoft Windows/386* and *DESQview 386* are so popular today.

Either of these programs can provide your 80386-based PC with an advanced multitasking operating environment that lets you switch instantly between the DOS applications you already have and know. Working with simple, on-screen instructions, you can quickly turn your machine into a number of "virtual" machines, each of which can simultaneously run a standard DOS program.

You can get either *DESQview 386* or *Windows/386* running in only a few minutes, but with a little extra tinkering and a little customization, you can unleash even more power from these already powerful environments. This installment of PC Lab Notes will show you how you can optimize memory usage, automate everyday routines, and even improve their speed. To help you decide which program is best for you, we'll start by looking at how each works and then consider ways to maximize their performance.

MEMORY MANAGEMENT Before selecting either program, you should make sure that you have enough and the right kind of memory. Although both *DESQview 386* and *Windows/386* will work with less, you won't be happy with their performance unless you have at least 2 megabytes of RAM in your system. Four or more is better still. The kind of extra memory you add will have a dramatic effect on the performance you get from these operating environments.

Both *DESQview 386* and *Windows/386* are designed to use both conventional and extended memory. Conventional memory is the 640K that's normally used by DOS programs. It's sometimes called real or real-mode memory because that is the operating mode that 80286 and 80386 microprocessors use when they emulate the operation of the 8088 microprocessor used by PCs, XTs, and PS/2 Models 25 and 30.

Extended memory is memory that cannot be addressed by 8088 microprocessors. It's sometimes referred to as protected-mode memory because 80286 and 80386 microprocessors use this memory area when they are operating in their protected mode.

Neither *DESQview 386* nor *Windows/386* want, use, or even expect to find any expanded memory in your system. Instead, both programs emulate the EMS (expanded memory specification) themselves, turning extended memory into expanded memory both for their own use and for the use of programs designed to take advantage of it. How the two programs allocate the available memory resources is detailed in Figures 1 and 2.

In *Windows/386*, the facilities for converting extended memory into expanded memory are built into the program itself and work automatically whenever you load it. *Windows/386* will co-reside with other expanded memory systems (such as an Intel Above Board and its software driver), but if any such expanded memory is installed in your system when *Windows/386* is loaded, the multitasking environment will completely ignore it. In practical terms, this means that if you run *Windows/386* part of the day and want to provide expanded memory to applications outside that environment, you can install and access EMS as you normally would. However, any separately controlled EMS memory will not be available to *Windows/386*.

PRODUCTIVITY INDEX

PC LAB NOTES
Tips on optimizing memory usage and automating everyday routines.
UTILITIES
SETUP lets you tell your printer exactly how to print a file.
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An explanation of IBM's technical documentation for OS/2 1.1.
POWER PROGRAMMING
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■ PC LAB NOTES

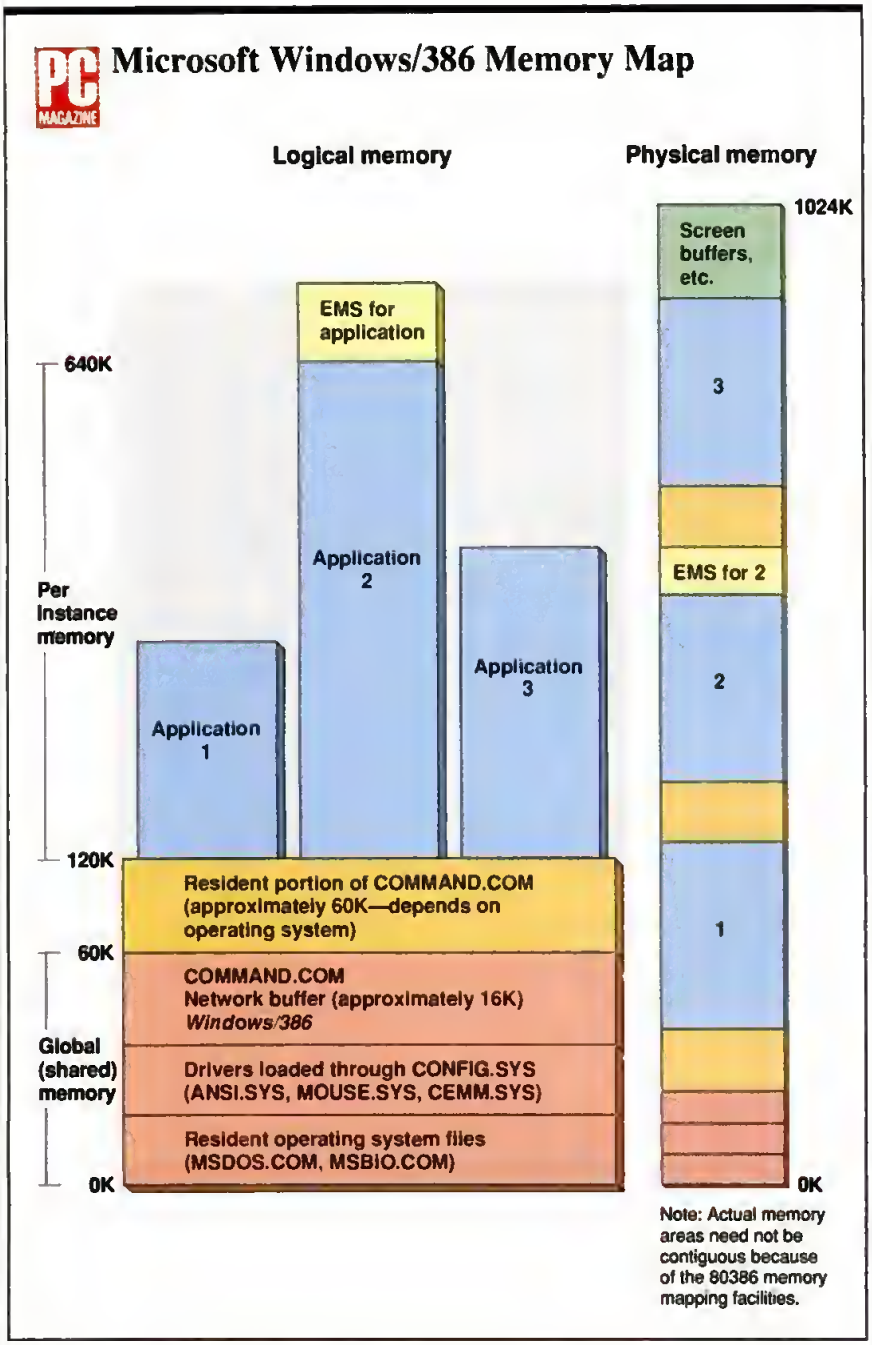

Figure 1: *In the* Windows/386 *memory scheme, physical memory that's shared by all virtual machines is called "global memory," of which only about 60K is required from the host computer system. However, each virtual machine running under* Windows/386 *loses a corresponding 60K from the 640K addressing range available to the applications running within it. The balance of the RAM in the system is divided among virtual machines according to the parameters in the .PIF file associated with each machine. Of the memory assigned to a given machine, called "per instance" memory by Microsoft, only a few kilobytes are used for system overhead. The rest is available for running applications.* Windows/386 *can dynamically allocate any part of memory for any purpose, so the memory used by the various virtual machines cannot be readily distinguished.*

DESQview 386 presents a different situation. The program is actually made up of two separate products: *DESQview* 2.2, which will run on nearly any system, and its extraordinary memory manager, *QEMM-386*, which taps the specific features of the 80386 microprocessor to give *DESQview* more memory to romp in. One of *QEMM-386*'s jobs is to create EMS 4.0 memory for use by *DESQview* and by your applications.

Unlike *Windows/386*, however, *QEMM-386* does not get along with other expanded memory drivers, and trying to use *QEMM-386* together with the software driver that accompanied your expanded memory board may cause your system to crash. If you need to run *1-2-3* with large, expanded-memory-only spreadsheets, you can do so simply by running *1-2-3* under *DESQview 386*.

Alternatively, you can switch the memory on your EMS board to extended memory and let *QEMM-386* turn it into expanded memory. Because the *QEMM-386* driver will provide EMS support even when your multitasker isn't loaded, a program like *1-2-3* will still be able to exploit EMS memory from DOS.

When you add memory to your system for either *Windows/386* or *DESQview*, the best choice is always fast 32-bit RAM. In most cases, that means adding the proprietary RAM expansion boards sold by the maker of your computer.

Unfortunately, proprietary RAM memory boards are usually the most expensive kind to add. That's not because the chips are 32 bits wide (actually, nearly all personal computer memory is made from the same kind of 8-bit memory chips), but because no clear standard has been established for 32-bit memory boards. Consequently the boards for Compaq, Tandy, IBM, AST, and other 386-based PCs are not interchangeable. Low volume and a controlled market make for higher prices. Your long-term upgrade option is something to keep in mind when choosing a 386 PC brand.

If you already have an EMS board, you can generally use it to enhance your system and give either *DESQview 386* or *Windows/386* more working room. What you must do, however, is set up the board to give you extended memory, *not* expanded

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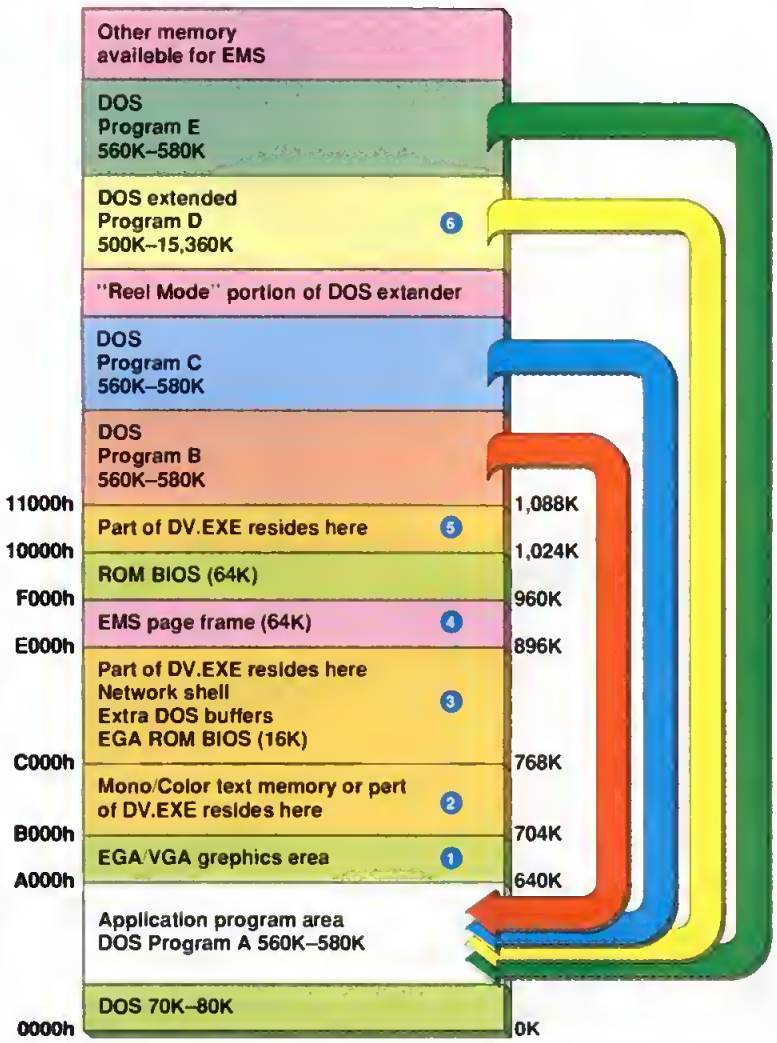
The DESQview Memory Map



The DOS programs are actually loaded into physical memory located above 1MB (1,024K). The virtual machines are then mapped into the area below 640K when the program code is running. DOS can then see any of the areas. The DOS arae is mapped from the same physical location into the same logical location in each virtual machine. *DESQview* mekes sure that DOS is not active in more than one program at a time, and thet any information required to be specific to that program is saved end restored from the *DESQview* data areas.

1. The EGA/VGA graphics area is a 64K RAM window into 256K memory on the board. Graphics programs bank-switch "planes" into this area and then update the bits for a particuler color.

2. This is the area for text display. Usuelly there is only one monitor. If so, then the 32K unused erea is used to store part of DV.EXE. The XDV.COM program breaks up the DV.EXE file into pieces end puts them into these disjoint areas.

3. Thia area may have other ROMs and could be configured differently; this is just an example. The DOS buffers and network shell were placed here using *QEMM-386*'s LOADHI feature. Other TSRs could be in this area as long as enough space is free. The DV.EXE part is placed into this area by SDV.COM; it is usuelly 40K to 60K in size.

4. The EMS page frame is for the use of programs thet use expanded mamory. In addition, about 32K of DV.EXE is stored here by XDV.COM.

5. This address renge is the first 64K of extended memory. It is accessed by turning off the A20 wrap in the computer's hardware. Thus a segment starting at FFFEh can access almost 64K of contiguous memory. This is a very touchy area, end only those extremely familier with its restrictions should try to eccess it.

6. This is e program that may be huge in size, several megabytes if needed (such as *Paradox 386* or IBM's *Interleaf*). It is designed and linked with a DOS extender that supports the Quarterdeck/Pher Lap Virtual Control Program Interface (VCPI). It has e small (about 150K) area that must be mapped below 640K. The rest is ectually above 1,024K in e lerge, contiguous area. The DOS extended aree controls moving in and out of reel mode. Several such large programs may be loaded.

Figure 2: *As with other 80386 memory managers,* DESQview *maps each virtual machine, which may use physical memory in the extended addressing range, into the DOS 640K addressing range during the time-slice that machine is executing. While the code used by each machine is loaded above DOS,* DESQview *keeps only one copy of DOS in memory so that physical memory is not wasted on redundant copies of the operating system. In the latest versions of* DESQview*, the operating code for the environment is executed in high memory, freeing up more of the 640K DOS range for use by applications. Extended memory can be used for application code as well as for expanded memory that can be shared among all virtual machines.*

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memory. Any memory on the board that you configure as expanded is likely to be wasted. The instruction manual provided with your EMS board will explain how to set the DIP switches (or its other configuration options) to yield nothing but extended memory.

Note that some EMS boards provide configurations that allow you to defeat some of the base memory of your system to take advantage of the greater bank-switching ability of EMS 4.0 memory. Don't select this option if it is offered. Not only will such a strategy not help, it will actually steal memory from your applications. Just configure your system for the maximum possible DOS memory.

Because nearly all AT-style memory boards use a 16-bit bus interface, this add-in memory won't work as fast as the 32-bit base memory of your 80386-based system. Because these operating environments start allocating memory with the conventional DOS memory area first and then take memory from the extended addressing range, the first program or two you load will generally run fastest. Thus you should always load your most important application first if you're using a 16-bit memory board.

In most cases, you won't be able to use 8-bit expanded memory boards that were designed to add EMS to PCs and XTs. Such boards usually don't offer you the option of using them in an extended memory configuration. Even if they did, however, you wouldn't want to use them in a multitasking 386 operating environment. They would impose so many wait states that your system's performance would be unendurably slow.

MOUSE PRIORITIES Curiously enough, the interrupt that you assign to your mouse when you set it up will affect how smoothly other programs will operate with *DESQview 386* or *Windows/386*. If you have a bus mouse, you're best off assigning it to use interrupt 5 (which is set up via a jumper). A serial mouse is best run via interrupt 4, which is what you select when you assign the mouse to use COM1. (Although this scheme may seem to defy logic, COM2, which you will then use for your modem, has a higher priority than COM1 because it uses interrupt 3.) These interrupts have lower priority than the others that are available, putting the mouse further down the line when demands are made on system resources.

The reason for giving the mouse a low priority is that many mouse drivers have a tendency to lock system interrupts for inordinately long periods. This can cause problems for devices that use interrupts with lesser priority. For instance, if your mouse has a higher priority than your serial port and you're engaged in high-speed communications, you may lose characters when the mouse locks the interrupts. Giving the mouse the lower priority will reduce such problems.

■ Both *DESQview 386* and *Windows/386* take away a lot of the attraction of TSRs. After all, if you can pop *anything* up instantly, why settle for tiny, limited applications?

TAMING TSRs Both *DESQview 386* and *Windows/386* take away a lot of the attraction of TSR programs. After all, if you can pop *anything* up instantly, why settle for tiny, limited applications? Still, people like to work with the utilities they've become familiar with, and habit might lead you to load your TSR programs as you always have, before starting the multitasking environment.

That's not a good idea for a couple of reasons. For one thing, strange conflicts are likely to crash your system at odd times. In addition, loading utilities *before* the new operating environment will reduce the memory available to each and every virtual machine the environment creates.

Remember, even when running under a multitasking environment with more than 1MB installed, your normal DOS programs still see only the normal DOS environment, with its 640K addressing limit. Applications, active terminate-and-stay-resident (TSR) programs, and device drivers must all share this limited address range. Instead of having 600K available to programs within a virtual machine, a heavy load of TSR utilities could cut the potential down to 300K or less—no matter how much memory you have physically installed in your system.

The best technique, then, is to load each of your customary pop-up utilities into its own virtual machine and leave it popped up. Then simply use the facilities of the operating environment to switch to that virtual machine whenever you need the TSR. By taking advantage of the facilities made available by the multitasking environment in this way, you can squeeze a bit more useful space from the megabyte of real-mode addressing range, making more memory available for every virtual machine that you run.

The considerations that have been discussed so far apply both to *DESQview 386* and to *Windows/386*. Now let's turn to some specific advice for each of the two environments, beginning with the *DESQview 386* program.

OPTIMIZING QEMM *QEMM-386* is a device driver, which means it must be loaded through your system's CONFIG.SYS file. When you're through with the *QEMM-386* modifications that I'll explain below, your CONFIG.SYS file will probably look something like this:

```
DEVICE=VDISK.SYS
DEVICE=QEMM.SYS RAM ROM I=F000-F7FF
DEVICE=LOADHI.SYS ANSI.SYS
BUFFERS=2
FILES=40
```

While it's best to load disk drivers (such as those that give you extra hard-disk partitions) before *QEMM*, the line beginning `DEVICE=QEMM.SYS` should be near the top of the CONFIG.SYS file. The most important consideration in loading *QEMM* is that it should run before any programs that may use expanded memory, such as disk caches or print spoolers. Since *QEMM* creates the expanded memory that these programs will use, obviously it must be set up first.

As shown above, you will want to include the word RAM on the `DEVICE`

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=QEMM.SYS line. This instruction causes *QEMM-386* to map extended memory into all the available places above the normal DOS area in the real addressing range of your microprocessor, making it available to DOS-based real-mode programs. In effect, this memory becomes available for loading device drivers and TSR programs outside of the DOS 640K memory area. (Such real-mode memory outside the normal DOS area is often called high memory because it represents the high end of the real-mode addressing range.)

Some computer systems have unused gaps in the real addressing range above the DOS 640K that even *QEMM-386* can't find by itself. By specifying these gaps on the DEVICE=QEMM.SYS line, in some systems you can recover 48K or more of extra real-mode memory space that *QEMM-386* would otherwise miss.

For example, if you have a Compaq Deskpro 386 with an EGA video board, simply including the command I=E400-EFFF on the QEMM.SYS line will free up about 48K of space for RAM. If your Compaq 386 has a VGA board, using the command I=E600-EFFF will give you an extra 40K.

With many system boards, you can reinstate the area that IBM reserves for its ROM-based Cassette BASIC language interpreter by including the instruction I=F000-F7FF shown above. Most non-IBM computers otherwise allow this address range to lie fallow. Even with a PS/2 Model 70 or 80 you can recover this area if you don't ever plan to use interpreted BASIC. By making use of this option, you will add an extra 32K to high-memory space for drivers and TSR programs.

To take advantage of such otherwise-wasted areas of real-mode memory, *DESQview 386* includes two special loader programs: LOADHI.SYS, which moves ordinary DOS device drivers into high memory; and LOADHI.COM, which does the same for TSRs. To use LOADHI.SYS, instead of loading device drivers directly through the CONFIG.SYS command DEVICE=*driver name*, you instead specify

```
DEVICE=LOADHI.SYS driver name
```

This will put the driver into high memory, as illustrated in the CONFIG.SYS file above, with the ANSI.SYS terminal emulator.

By using the LOADHI.SYS loader to move device drivers out of the normal DOS 640K addressing range, you'll have more memory for executing programs in *all* the virtual machines you use under *DESQview*. You can use LOADHI.SYS repeatedly for as many drivers as you normally load.

Because most device drivers are small (except for some used by networks), you're unlikely to run out of room for them above DOS. But you may discover that some of the device drivers that you normally use won't work when loaded into high memory. Unfortunately, the only way to find out what works and what won't is by trial-and-error testing. Thus, you'll want to convert your DEVICE= into DEVICE=LOADHI.SYS entries one at a time, rebooting your system after each change.

■ To move TSR programs into high memory, you simply add the command LOADHI before any line in your AUTOEXEC .BAT file that loads a TSR program.

When setting up *QEMM-386*, you'll also want to change the BUFFERS= line in your CONFIG.SYS file. As a memory manager, *QEMM-386* sets up its own disk buffers, so you don't have to waste memory space on those created by DOS—even if the applications you intend to run recommend that you put a specific BUFFERS=*xx* line in your CONFIG.SYS file. Make your CONFIG.SYS entry BUFFERS=2 instead of some larger number.

On the other hand, *don't* skimp on the number that follows FILES= when updating your CONFIG.SYS file. This number tells DOS how many file handles to have ready. This specification determines how many files DOS can juggle at the same time, and it costs very little memory to provide for additional handles. You may even want to increase this number to allow you to have more files open at the same time; 40 or 50 is probably about right.

QEMM-386 gives you one further option for your CONFIG.SYS file. Adding the word ROM on the DEVICE=QEMM.SYS line, as shown above, will cause *QEMM-386* to copy the code in your machine's BIOS routines from ROM into faster RAM memory, then map this fast RAM into the address range formerly used by the ROM. This technique, sometimes called *shadowing* ROM, is built into the hardware of many (but not all) 80386-based computers. *QEMM-386* simply duplicates the process in software. If your 80386 computer already has a ROM shadowing option built in, you should use that instead of the *QEMM-386* option. If it does not, *QEMM*'s ROM option will speed up the operation and display of nearly everything that you do with your computer. Note that some machines allocate a full 384K for shadow ROM. In this case, disabling the built-in shadow ROM and using *QEMM-386* will be beneficial because *QEMM-386* will use up much less than 384K.

PROGRAMS IN HIGH MEMORY

While device drivers are the province of your CONFIG.SYS file, loading TSR programs into real memory beyond the 640K DOS barrier requires a bit of tinkering with your AUTOEXEC.BAT file. For this purpose, *DESQview 386* provides a program loader called LOADHI.COM. This program works like the device loader LOADHI.SYS, but instead puts TSR programs into high memory. To move TSR programs into high memory, you simply add the command LOADHI before any line in your AUTOEXEC.BAT file that loads a TSR program. If, for example, you load *SideKick* from your DOS directory with the AUTOEXEC.BAT entry

```
\DOS\SK
```

you should change it to

```
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```

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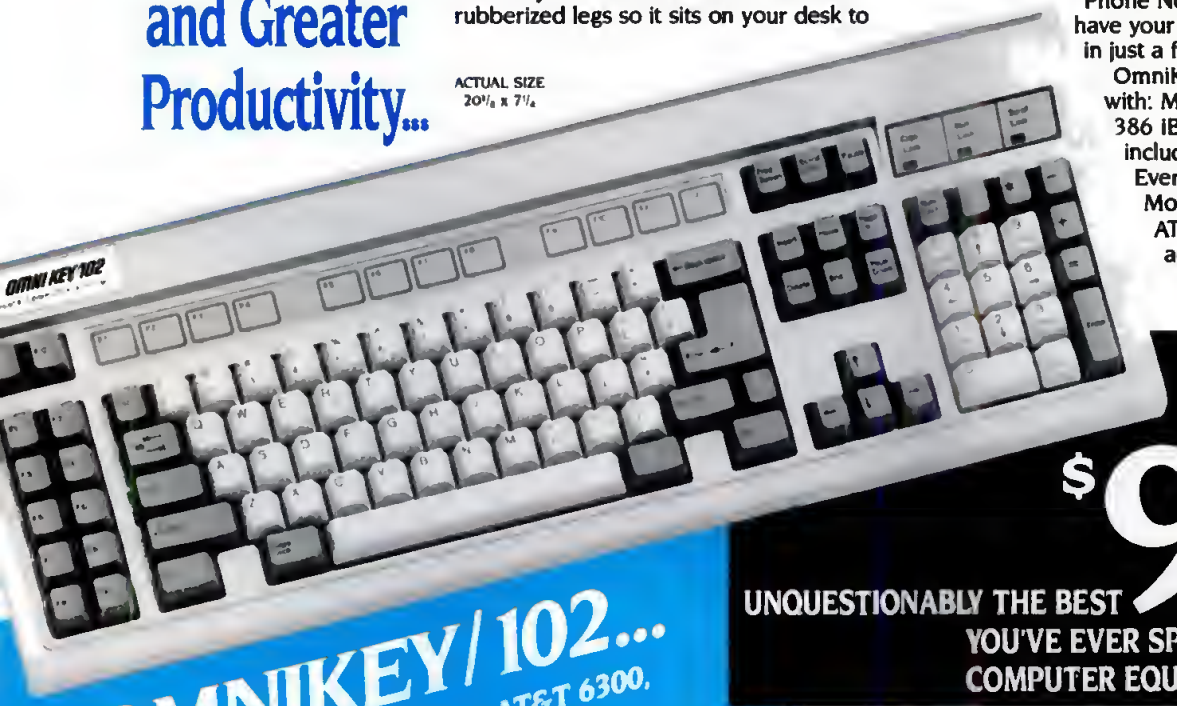

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grams into high memory as you specify—until it runs out of high-memory space. If insufficient high memory is available to load a TSR, LOADHI.COM will issue an error message and simply load the program into normal DOS memory without further ado. If the error message bothers you, you can just eliminate that final annoying LOADHI entry.

Of course, before LOADHI.COM (or LOADHI.SYS) will work, you'll need to have the high memory available, so don't forget to enter the RAM parameter on the `DEVICE=QEMM.SYS` line in your CONFIG.SYS file. You'll also need to be sure that LOADHI.COM is located in the logged directory (usually the root directory) or in a directory specified by a previously defined PATH statement so that DOS can find it.

SELECT DRIVERS CAREFULLY When you use a mouse with *DESQview* and you have your choice of mouse drivers to use, always use the Microsoft mouse driver. This driver has built-in features that help *DESQview* handle your computer's video system. Selecting this driver is especially important if you have an EGA display adapter board because some EGA registers cannot be read. Consequently *DESQview* can't figure out what's in these registers to display images properly when shifting screens. The Microsoft mouse driver tracks such changes, however, so *DESQview* can indirectly determine the proper settings of the various EGA registers. *Microsoft Word* particularly benefits from your using this driver.

FINAL STEPS Once you have your system set up to take best advantage of *DESQview*, you must make sure that you run the right version of the program. On the distribution disk, two variants of *DESQview* are included, DV.EXE and XDV.EXE. The former loads *DESQview* into normal DOS memory; the latter puts most of the *DESQview* code into the 80386-based computer's extended memory. Only a few 80386 computers are unable to use the XDV program, and by using the XDV version you'll free up an additional 140K of space for your DOS applications. You will be able to avoid confusion by copying only XDV.EXE to your hard disk and then renaming it to DV.EXE.

Microsoft recently announced a new driver, HIMEM.SYS, that allows *Windows/286*, Version 2.10, to take advantage of this same extended memory area. If you plan to run *Windows/286* under *DESQview 386*, make sure that *Windows/286* is configured *not* to use HIMEM.SYS and the memory area.

To configure *DESQview 386* and match it to your installed software, in most cases you'll want to use *DESQview*'s own automatic setup program. These procedures will search through all your disks and their directories for all the applications that *DESQview* knows how to work with and set up *DESQview* to match them. All of the programs that the installation procedure notes are fully compatible with *DESQview* and are generally set up optimally. With a few exceptions, you won't want to tinker with these factory settings.

■ *Windows/386* does not allow you as much flexibility as *DESQview*. The philosophy is that most users want to be bothered by as few details as possible.

After you've started using the program, however, you may want to do a little fine-tuning with *DESQview*'s Advanced Options menu. For example, you can sometimes get substantially better floppy disk performance by changing the preset value of 2 in the "DOS Buffer for EMS" field to 0. On most 80386-based systems (the only exceptions I've found involve some networks or a SCSI hard disk drive), this change will give extra zip to floppy disk operations. The default *DESQview* setting buffers the data on its way to and from your floppy disk. While this guards against overwriting memory used in Direct Memory Access (DMA) operations, I've found that *QEMM-386* itself manages memory and prevents possible DMA conflicts quite adequately, so the buffers aren't normally needed. Eliminating the buffers speeds up floppy-disk operations and will also save you a couple of kilobytes of RAM.

One default setting nearly everyone feels compelled to tinker with in the Advanced Options menu is the entry for "Task Processing Time." The settings here determine how many system clock ticks (each about 0.055 second long) are devoted in turn to the foreground and background programs. The *DESQview* defaults assign 9 ticks for foreground programs and 3 for background. While that's optimal for 8088-based systems, 80386 computers generally run more smoothly if you assign 4 ticks to foreground applications and 2 to those in the background.

When you add new programs to *DESQview*'s repertoire by invoking its "Add a program" option, it's especially important to include the full pathname and filename, *including* the .EXE or .COM extension. Otherwise, *DESQview* will load a copy of COMMAND.COM every time it runs the program. That steals about 4K from the memory available to the program within its virtual machine. Simply by being absolutely specific about the way you indicate your programs, you can save kilobytes in every virtual machine.

SETTING UP WINDOWS/386 Unlike *DESQview 386*, customizing *Windows/386* requires little fiddling with your CONFIG.SYS file. One reason for this is that EMS simulation is built into *Windows/386*'s code, so you don't need to load a special device driver to get EMS memory. Another is that *Windows/386* does not allow you to shoehorn drivers and TSR programs into high memory.

Thus, you'll normally want to leave your CONFIG.SYS file alone when moving up to *Windows/386*. The only exception is if you normally use a disk caching program to improve the performance of your hard disk. Eliminating any aftermarket disk cache (or one that came with your computer) and substituting instead the SMARTDRIVE.SYS software included with *Windows/386* will yield an important benefit. SMARTDRIVE was specifically designed to work cooperatively with *Win-*

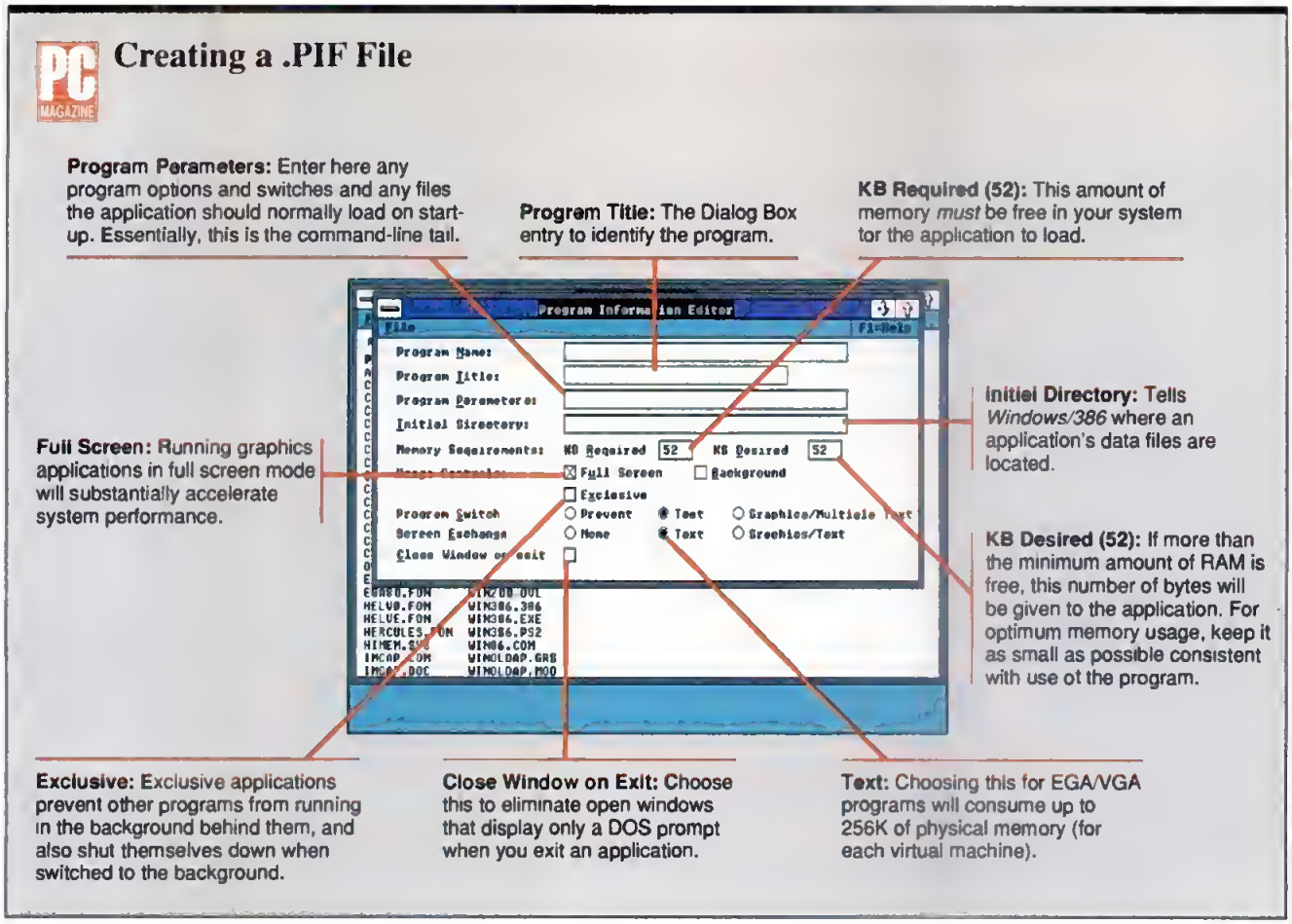

Figure 3: *The PIFEDIT utility included with* Windows/386 *facilitates entering the information the program needs to know about each of the applications that are to be run under it, such as how much memory to allocate for the application.*

dows/386 so that memory can be allocated dynamically. *Windows/386* can thus automatically draw memory away from SMARTDRIVE and give it to your applications as needed. Such sharing is not available with other disk caches.

The *Windows/386* installation procedure will automatically make the correct entry in your CONFIG.SYS file when you specify that you want to use SMARTDRIVE. Moreover, running SMARTDRIVE is not mandatory: *Windows/386* will function with other disk caches.

When setting up *Windows/386*, one point to note is that some applications try to steal all the EMS memory available in your system. If you try running another EMS application after one of these memory hogs, there won't be any EMS left for the new program! This may be the cause of your problem if you encounter mysteriously disappearing EMS after you run an application. You can avoid such difficulties by loading the offending program into *Windows/386* last.

OPTIMIZING WINDOWS/386 By design, *Windows/386* does not allow you as much flexibility in customization as does *DESQview*. The philosophy underlying the program is that most users want to be bothered by as few details as possible. Consequently, *Windows/386* doesn't allow you to tinker with time-slicing or memory allocation. However, several tricks can still help you get more from *Windows/386*.

For instance, if you want top performance, avoid running a graphics applications in the background or in a window. *Windows/386* cannot directly access the memory used by EGA or VGA graphic images, so it must do some fancy footwork to shuffle the bytes between foreground and background applications every time the display changes. That eats up a lot of microprocessor time. When a graphic application runs full-screen, however, no shuffling is needed, and the whole system runs faster.

Although *Windows/386* allows you to execute .COM and .EXE files directly, it's best to set up .PIF (Program Information File) files for the applications that you run most often. The best way to set up these files is with the PIFEDIT program supplied with 386, as shown in Figure 3. If it lacks a .PIF file, *Windows/386* assigns a full 640K to each virtual machine that you set up. That can waste a lot of memory if

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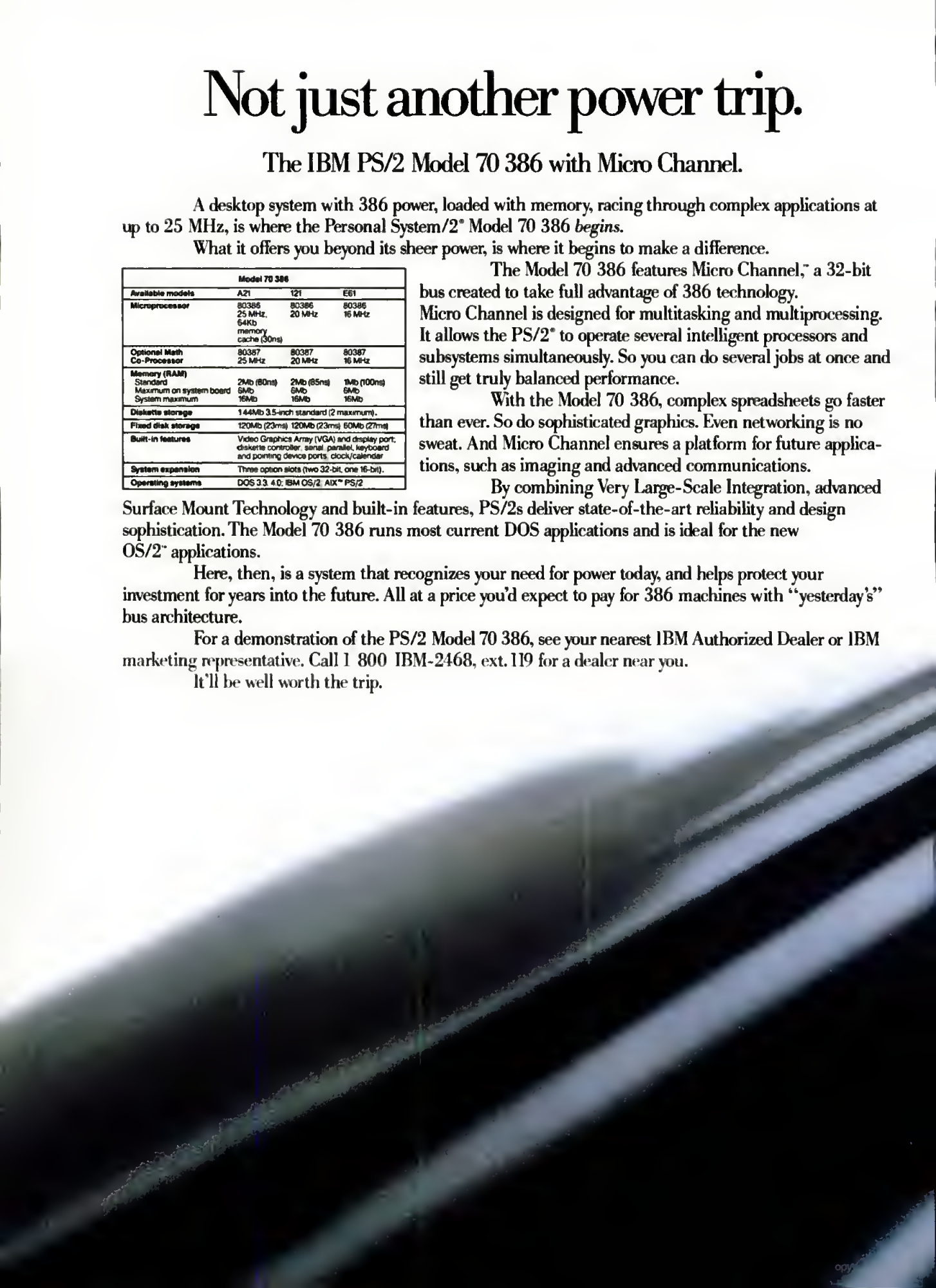

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■ PC LAB NOTES

your application doesn't need that much RAM. The .PIF file lets you set up the amount of memory *Windows/386* will allocate to the program.

The display mode you choose for your applications in their .PIF files can also have a dramatic effect on memory usage. Specifically, if you indicate that you want to make graphic screen exchanges and you're using an EGA or VGA display, *Windows/386* will reserve a full 256K of RAM as a display buffer in the virtual machine associated with that application. That's a huge waste if you're only going to use the text mode of an application; for instance, if you never use the graphics portion of *Lotus 1-2-3*. By choosing text-only for screen exchanges, you'll save nearly all of that RAM for use by other applications.

At least to a limited extent, .PIF files also let you modify the way *Windows/386* divides its time among applications. Normally, *Windows/386* allocates two-thirds of its time to the foreground applications and one-third to all the applications executing in the background. If you assign a program the exclusive attribute in its .PIF file, that application will take all your system's time and shut down background applications while it's in the foreground window. And when it is shifted to a background window, the exclusive application will stop executing.

There are other options you may want to set to your personal specifications that are controlled by the WIN.INI configuration file. This file is normally stored in the same directory as *Windows/386*. You can edit WIN.INI with any text editor that creates ASCII files, including the program's own Notebook editor.

Settings in WIN.INI determine to some extent how *Windows/386* deals with expanded memory. Normally, *Windows/386* runs in EMS memory and, by default, reserves a block of 640K for its own use. You can alter both of these arrangements to yield more memory for DOS applications.

If you don't plan on running any specific *Windows/386* applications and want to use the environment simply to switch between your DOS programs, you can trim the memory assigned to *Windows/386* down to 384K (or so) with the windowmemsize option in WIN.INI. It's listed under the subheading [win386].

To prevent *Windows/386* from using EMS memory, just start the program using its undocumented command-line option /N. The option follows the WIN386 command and precedes the name of any application that you want to start running under *Windows/386*. For example, to start *Windows/386* outside EMS and running the *Ami* word processor, your command line would be

```
WIN386 /N AMI
```

■ Normally *Windows/386* runs in EMS memory and reserves a block of 640K for its own use. You can alter these arrangements to yield more memory for DOS applications.

The /N option is also handy when you are troubleshooting *Windows/386*. If your system locks up the first time you try to load the program—particularly when you have a network adapter in your computer—try loading *Windows/386* with the /N option. If it then works, you've discovered a conflict between the EMS drivers inside *Windows/386* and other software in your system. Not only have you identified the problem, but also you can use *Windows/386* in this mode until you get a fix. (Some network suppliers have bug-fixes that correct such problems. Check with your vendor or with the technical support people for your network.)

In setting up your WIN.INI file, you should be aware that some peripherals use memory areas that you don't know about and that *Windows/386* may not discover for itself. IBM Token-Ring adapters and the 8514/A display adapter, for example, have such reserved memory areas. If you have either of these devices in your system, you can prevent conflicts—which might confuse displays or crash your system—simply by including the line

```
emmexclude=B0000-B4FFF
```

in the [win386] section of WIN.INI.

Another modification you might want to make if your computer is connected to a network is to defeat the print spooler built into *Windows/386*. The setting of the spooler is stored in WIN.INI under the heading [386] and is On by default. The only time this choice is not desirable is when your network has its own print spooler. You don't normally need more than one spooler in a system, so just change this option to Off.

Another option in WIN.INI allows you to print anything you want to a file instead of to your printer. For instance, you may need a PostScript file to send to a type supplier or to use with one of the new PostScript interpreters that work with non-PostScript printers. To give yourself this option, simply include a filename with the extension .PRN followed by an equals sign, under the [ports] heading of WIN .INI. That filename will thereafter appear as one of the printer choices shown in the *Windows/386* Connections dialog box.

WIN.INI also allows you to specify a default set of applications to load each time you start *Windows/386*. To have *Windows/386* come up with an application running in its foreground window, specify either the name of the program or the name of its .PIF file after the `run=` option under the [386] heading in WIN.INI. Using the `load=` option, you can specify as many programs as you like (or will fit into the memory of your system) to load into the background of *Windows/386*. Although neither `run=` nor `load=` lets you specify any command-line options (such as files to immediately load for editing when the window opens), you can indicate these in the .PIF file assigned to each program.

The *Windows/386* environment provides you with a "panic button" to press when an application crashes. Hit Alt-Spacebar, and you'll get the system menu. Choose the bottom selection, Settings, and you'll get another dialog box, where you'll find a special option labeled "terminate." Choosing that will close the ill-behaving active window and, in most cases, will re-

trieve your machine-gone-awry. After invoking the terminate option, you'll still have to pick up the pieces of the broken window (CHKDSK /F will collect any orphan clusters that may be left scattered across your disk), but you probably won't have to reboot your computer and lose your other ongoing work.

If you plan on using your mouse only with the *Windows/386* menu control system or with applications written for it, you don't have to load your mouse driver at all. Support for most mice is built into *Windows/386*. You merely need to specify the type of mouse that you have during the *Windows/386* setup procedure.

On the other hand, if you plan on using a mouse with standard DOS applications—like *Microsoft Word* or a non-*Windows/386* drawing or CAD program—you'll still have to load your mouse driver when you use *Windows/386*. Note, however, that if only one or two of the many applications that you want to run use a mouse, you should load the mouse driver within the virtual machine of the program that requires mouse support. That way the mouse driver won't steal memory space from applications that can't use it.

This strategy applies only when your mouse driver is available in both .SYS and .COM file forms, as is Microsoft's own mouse driver. If your mouse driver is available only in .SYS form, you'll have to load it through your system's CONFIG.SYS file, in which case it will be available to all applications that run on your computer.

WHEN TO USE BOTH The array of choices for using these two 386 environments can be bewildering. While they open up many new possibilities, you'll find there are limits to this new power.

For instance, you might want to multitask *Windows*-specific applications *and* install drivers in high memory. If you install *QEMM-386* to use its RAM facility, however, *Windows/386* won't run, since only one DOS program can manage protected-mode programs. The solution in this case may be to run *Windows/286* (the non-386 version) sessions under *DESQview 386*. You won't be able to use the *Windows/386* clipboard to transfer data between applications this way, but you'll enjoy plenty of memory for each individual *Windows/386* application. If you run multiple *Windows*-specific applications under *Windows/386*, however, the system starts swapping code to disk when the 640K limit is reached.

Use the above as guidelines, but don't get frustrated when you find incompatible programs. If you're eager to multitask without OS/2, you'll have to experiment. PC

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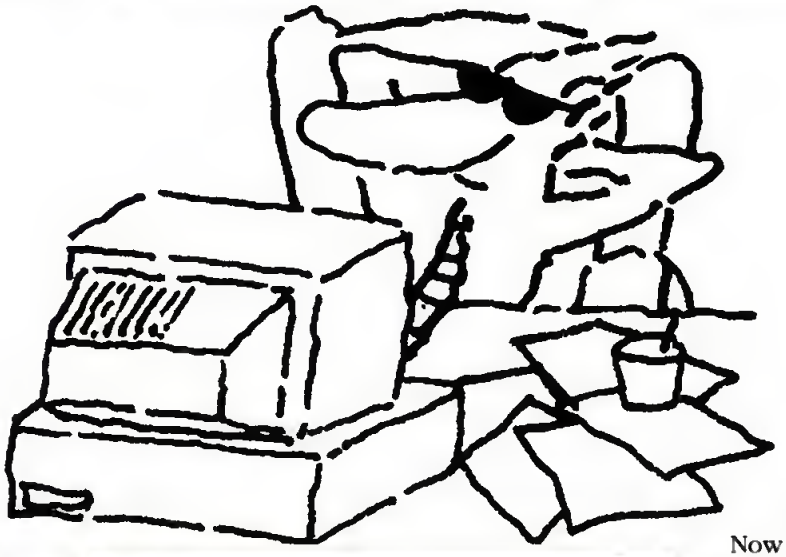

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```
<ESC>"&l1o2e5.647c66F"<ESC>"&k2S"
```

before sending the file to the printer.

In the June 24, 1986, issue of *PC Magazine*, SETUP.COM gave users of the popular Epson RX/FX series dot matrix printers a way to invoke many of its cryptic control codes from within an application. However, modifying SETUP to send other escape sequences required some familiarity with either a macro assembler or with DEBUG.COM.

SETUP2 is a highly customizable version of SETUP that reflects the need to keep up with advancing hardware and to grow as your printing needs become more sophisticated. It lets you create your own printer menus and control code sequences with ease, using only a standard ASCII text editor or word processor. Just as easily, you can modify those menus when you change printers or decide to squeeze more out of your old one. While the original SETUP was limited to one printer menu with ten configuration options, SETUP2 permits as many as memory will hold. Should you need to send a one-time escape sequence you didn't build into your default printer menu, SETUP2 lets you key in text and control codes on-screen and output them directly to your printer.

As always, the easiest way to get a copy of SETUP.COM is to download it directly from PC MagNet, as explained in the accompanying sidebar "SETUP2 by Modem." The alternative is to create the .COM file either from the SETUP2.ASM source code or from SETUP2.BAS, both of which are listed here and are also available via PC MagNet. SETUP2.BAS will automatically create SETUP2.COM when you run it once in BASIC. To create SETUP2.COM from its source code, you must use a macro assembler (IBM or Microsoft, Version 2 or later) and the commands:

```
MASM SETUP2;
LINK SETUP2;
EXE2BIN SETUP2 SETUP2.COM
```

Then delete the .OBJ and .EXE files that were created en route.

USING SETUP2 Like its progenitor, the SETUP2 program is a RAM-resident utility that sits quietly in the background and waits for you to press the keys that pop it up. Its complete syntax is

```
SETUP2 [d:][path][filename] |
  [/C codes] | [/U]
```

where *filename* is the name of a Printer Make File (I'll simply call this a PMF file hereafter) that contains your printer menu and control codes, as discussed below. Once it is loaded—normally through your AUTOEXEC.BAT file—you can uninstall SETUP from memory by invoking it with the /U option, provided no subsequently loaded TSRs stand in the way. If you simply want to send a string of text or control codes from the command line without making SETUP2 RAM-resident, the /C *codes* option will let you do so. This feature is particularly useful when using SETUP2 in batch files.

You can also use the /C option simply to take SETUP2 for a quick test drive. At the DOS command prompt enter the first line below if you have an Epson-compatible dot matrix printer, or enter the second line if you have a Hewlett-Packard LaserJet or compatible:

```
SETUP2 /C 15,"Printer Test",13,10
SETUP2 /C 27,"&k2S","Printer Test",
  13,10,27,"&l0H"
```

Your printer should print the text "Printer Test" in compressed type. The /C command line switch instructs SETUP2 to transmit the codes and text that follow to the printer after converting any numbers typed outside quotation marks into their binary equivalents. In the sample line above, the printer is first set to compressed mode, then text and a terminating carriage return/line feed pair are transmitted. (In the case of the LaserJet, a page eject command

■ SETUP2 lets you create your own printer menus and control code sequences with ease, using only a standard ASCII text editor.

Defining Printer Menus and Control Code Sequences with PMF Files

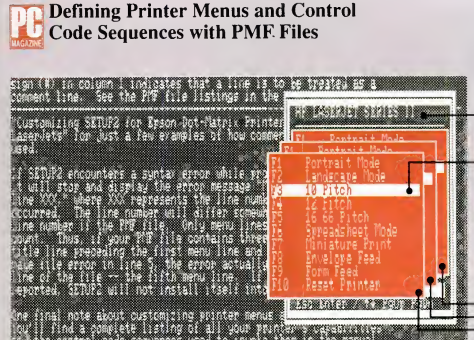

Figure 1: *This illustrates the general format of a SETUP2 Printer Make File (PMF). The first ten lines of the PMF file will appear on page 1, the second ten on page 2, and so on, until every line contained in the PMF file is displayed within the menu window. Note that the menu text and control code fields on a given line must be separated by a semicolon (see Figure B in the sidebar "Customizing SETUP2 for Epson Dot Matrix Printers and HP LaserJets"). In addition, comment lines may be inserted anywhere in the file for documentation purposes. Such lines are identified by entering a pound sign (#) in column 1. Everything on a line after the pound sign is ignored by SETUP2's processing routines.*

is also sent.) If your printer is off-line, powered off, or otherwise not ready to receive data, SETUP2 will respond with the message "Printer not ready."

SETUP2 interprets either double or single quotes to mean that the text they enclose is to be treated literally. Numeric entries may be separated by commas, spaces, or tabs and are not case-sensitive. Numbers are normally entered in decimal, but they may alternatively be entered in hexadecimal format by preceding them with an x or 0x (the C-language style). The Epson control code sequence shown above, for example, could have been entered as either of the following lines:

```
SETUP2 /C 0x0F,"Printer Test",0x0D,0x0A
SETUP2 /C xf 'Printer Test' xd xa
```

If you make a mistake typing a code string, SETUP2 will notify you with the error message "Invalid code string."

When you run SETUP2 without the /C option, it becomes RAM-resident. The default hotkey is the Ctrl–Right Shift key combination, which pops up SETUP2's printer menu window. Pressing the Esc key closes the window and returns you to the program you temporarily interrupted.

If SETUP2 is installed without providing it with a PMF *filename*, Ctrl–Right Shift will bring up an empty window, of course, but even from this you can see how the menu will work. At the top of the window is a blank line that will hold the name of your printer (or any other text you'd like to enter there, such as your name) once you've configured the program. Below it are ten blank lines with function-key labels F1 through F10 on the left. Below that is a highlighted input bar.

If you now press the Slash key (/), a cursor will appear in the input bar. Here you can enter text and control codes to send output directly to the printer just as you did previously from the command line, using the /C option. You can enter up to 100 characters in the input bar. As you do, the text will scroll to the left. The Enter key ends text input and transmits the codes; the Esc key aborts the input process without sending anything to the printer. Again, if the codes you type contain errors, SETUP2 will beep, display the message "Error: Invalid entry" on the line beneath the input bar, and give you a chance to go back and edit the entry. If the codes are valid but the printer isn't ready, SETUP2 responds in a similar manner with the message "Error: Printer not ready." And if the transmission succeeds, the cursor will disappear and you'll be placed back in the menu area.

CUSTOMIZED MENUS The PMF file is the mechanism SETUP2 uses for custom configuration of its menus and control codes. Figure 1 shows the structure of the PMF file format graphically; "Customizing SETUP2 for Epson Dot Matrix Printers and HP LaserJets" provides sample PMF listings for Epson-standard dot matrix printers and for HP LaserJets.

A PMF file is nothing more than an ASCII listing of the menus you want to see when you pop up the window, together with the control codes that correspond to them. PMF files can be created with any ASCII program editor or text editor or any word processor that will save files in generic ASCII format. In the absence of anything better, EDLIN will suffice. Better yet, try TED, the tiny text editor published in this column in the November 15, 1988, issue. If you use *WordPerfect* as an editor, on the other hand, *don't* save a PMF file as you would a normal word processing file. Instead, use the Text In/Out menu (accessed with Ctrl-F5) to write it out as a DOS text file.

The first line in a PMF file will appear

CUSTOMIZING SETUP2 FOR EPSON DOT MATRIX PRINTERS AND HP LASERJETS

A simple ASCII text editor is all it takes to configure SETUP2. Two sample PMF files—one for Epson RX and FX series dot matrix printers, the other for HP LaserJet printers—are given in Figures A and B to start you off.

Note the use of comment lines to enhance readability and to separate pages of menu text. The text of each menu line ends with a semicolon. For appearance sake, the control codes that follow are left-aligned with tabs and spaces. SETUP2 ignores the space between semicolons and the start of the control codes.

The first sample PMF file provides two full pages of menus for printers with Epson-compatible command sets. If you have an FX model rather than an RX, you might want to add an NLQ/draft option to switch easily from draft mode to near-letter-quality mode and back. Most of the entries in this file will work with Epson MX series and IBM dot matrix printers as well.

The second PMF file is designed for Hewlett-Packard LaserJet printers and compatibles. As this example illustrates, you don't have to make the number of menu entries an exact multiple of 10; SETUP2 simply pads unused lines on the final page with blanks.

The control code combinations shown here represent only a few of the many possibilities provided by HP's Printer Command Language. The Spreadsheet menu selection on the second page illustrates how a number of unrelated codes can be combined for a single purpose: in this case, to prepare a LaserJet to print spreadsheet data in compressed landscape format. The remaining menu entries on the second page control typeface selection. If desired, you could combine control codes for typeface, stroke weight, pitch, spacing, and other elements that factor into font selection to build a series of complete font selection menus.—**Jeff Prosise**

```
#=============================================
# Epson RX/FX-80 Printer Make File
# Copyright (c) 1989 Ziff Communications Co.
#=============================================
EPSON RX/FX-80 PRINTER
Compressed Mode On;      15
Compressed Mode Off;     18
Expanded Mode On;        27,"W1"
Expanded Mode Off;       27,"W0"
Emphasized Mode On;      27,"E"
Emphasized Mode Off;     27,"F"
Double-Strike On;        27,"G"
Double-Strike Off;       27,"H"
Miniature Mode On;       15,27,83,0,27,65,6
Miniature Mode Off;      18,27,84,27,50
#---------------------------------------------
Elite Mode On;           27,"M"
Elite Mode Off;          27,"P"
Skip Perforation On;     27,78,8
Skip Perforation Off;    27,79
1/8" Line Spacing;       27,"0"
7/72" Line Spacing;      27,"1"
1/6" Line Spacing;       27,"2"
Line Feed;               10
Form Feed;               12
Reset Printer;           27,"@"
. . . . . .
```

Figure A: *The menu entries and codes shown above give the most-frequently needed control sequences for Epson dot matrix printers.*

```
#=============================================
# HP LaserJet Printer Make File
# Copyright (c) 1989 Ziff Communications Co.
#=============================================
HEWLETT-PACKARD LASERJET
Portrait Mode;           27,"&l0O"
Landscape Mode;          27,"&l1O"
10 Pitch;      27,"&k0S"
12 Pitch;                27,"&k4S"
16.66 Pitch;             27,"&k2S"
Light;                   27,"(s-3B"
Medium;                  27,"(s0B"
Bold;                    27,"(s3B"
Form Feed;               12
Reset Printer;           27,"E"
#---------------------------------------------
Line Printer;            27,"(s0T"
Pica;                    27,"(s1T"
Elite;                   27,"(s2T"
Courier;                 27,"(s3T"
Helvetica;               27,"(s4T"
Times Roman;             27,"(s5T"
Gothic;                  27,"(s6T"
Spreadsheet;             27,"&l1o2e5.647c66F",27,"&k2S"
. . . . . .
```

Figure B: *Your LaserJet has a more complete list of the codes provided by Hewlett-Packard's Programming Control Language.*

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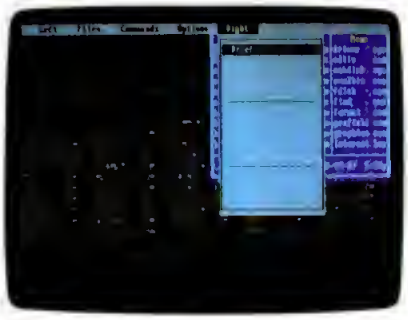

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■ UTILITIES

```
;=============================================================================
; SETUP 2.9 allows text and control codes to be sent directly to a printer
; from the command line or from within a popup menu window.  Syntax is:
;
;       SETUP2 [d:][path][filename] | [/C codes] | [/U]
;
; where filename = Name of PMF file
;       /C = Codes to be sent from the command line
;       /U = Uninstall the program
;=============================================================================

code            segment para public 'code'
                assume  cs:code
                org     100h
begin:          jmp     initialize

progrme         db      "SETUP 2.0 "
copyright       db      "(c) 1989 Oiff Communications Co.",13,10
author          db      "PC Magazine ",254," Jaff Prosise",13,10
hotkey          db      "Hotkey is Ctrl-Alt/Shift",13,10,"$",1Ah

videocols       db      ?                       ;number of columns displayed
videopage       db      ?                       ;active video page
videoseg        dw      ?                       ;video segment
videostart      dw      ?                       ;starting video address
videocursormode dw      ?                       ;cursor description
videocursorpos  dw      ?                       ;BIOS cursor position

pname           db      29 dup (29h)            ;menu window title
lpt_number      dw      0                       ;LPT port number
status          db      0                       ;program status flag
int9h           dd      ?                       ;interrupt 9h vector
window_start    label word
window_x        db      ?                       ;starting window column
window_y        db      1                       ;starting window row
window_end      dw      ?                       ;lower right window corner
border_attr     db      ?                       ;border color
menu_attr       db      ?                       ;window color
hilite_attr     db      ?                       ;highlight color
cursor_def      dw      ?                       ;default cursor definition
index           db      0                       ;menu selection index
ten             db      10                      ;base 10 divisor
linecount       dw      0                       ;number of menu lines
pagecount       db      1                       ;number of menu pages
menupage        db      0                       ;current menu page
code_table      dw      offset menu_table       ;address of control code table
end_offset      dw      offset menu_table       ;ending program address

;=============================================================================
; KBINT receives control when an interrupt 9 is generated.
;=============================================================================
kbint           proc    far
                pushf                           ;call BIOS keyboard routine
                call    int9k
                sti                             ;enable interrupts
                push    ax
                mov     ah,2                    ;get shift key status
                int     16h
                and     al,0Fh                  ;mask off upper four bits
                cmp     al,5                    ;was the hotkey combo pressed?
                pop     ax
                jne     kb_exit                 ;no, then exit
                cmp     status,0                ;check program status
                jne     kb_exit                 ;exit if it's already up
                call    main                    ;pop up the window
kb_exit:        iret                            ;exit
kbint           endp

;=============================================================================
; MAIN is the main body of the program.
;=============================================================================
main            proc    near
                mov     status,1                ;set program status flag
                push    ax                      ;save all registers
                push    bx
                push    cx
                push    dx
                push    bp
                push    si
                push    di
                push    ds
                push    es
                mov     ah,15                   ;abort if the current video
                int     10h                     ;  mode is not a text mode
                cmp     al,7
                je      main1
                cmp     al,4
                jb      main1
;
;Restore register values and return to caller.
;
main_exit:      pop     es                      ;restore registers
                pop     ds
                pop     di
                pop     si
                pop     bp
                pop     dx
                pop     cx
                pop     bx
                pop     ax
                mov     status,0                ;clear program status flag
                ret
;
;Save video parameters and read the cursor address from the CRT controller.
;
main1:          push    cs                      ;establish DS addressability
                pop     ds                      ;  by pointing it to the
                assume  ds:code                 ;  code segment
                cld                             ;clear DF for string ops
                mov     videocols,ah            ;save columns displayed
                mov     videopage,bh            ;save active video page
                mov     ah,3                    ;get cursor information
                int     10h
                mov     videocursormode,cx      ;save cursor mode
                mov     videocursorpos,dx       ;save cursor position
                mov     ax,40h                  ;point ES to the BIOS
                mov     es,ax                   ;  data area
                mov     dx,es:[4Eh]             ;save video start address
                mov     videostart,dx
;
;Define monochrome or color video attributes.
;
                test    byte ptr es:[63h],40h   ;branch if this is
                jne     colorvideo              ;  a color system
                mov     videoseg,0B000h         ;monochrome attributes
                mov     border_attr,70h
                mov     menu_attr,07h
                mov     hilite_attr,70h
                mov     cursor_def,0C0Dh
                jmp     short vsave
colorvideo:     mov     videoseg,0B800h         ;color attributes
                mov     border_attr,70h
                mov     menu_attr,47h
                mov     hilite_attr,70h
                mov     cursor_def,0607h
;
;Save video memory underlying the menu window, then open the window.
;
vsave:          mov     ah,1                    ;hide the cursor
                mov     ch,20h
                int     10h
                mov     cl,videocols            ;determine window position
                sub     cl,32
                mov     window_x,cl             ;save starting column number
                mov     ch,window_y
                mov     dx,cx
                add     dx,101Dh                ;save coordinates of lower
                mov     window_end,dx           ;  right window corner
                push    cs                      ;point ES:DI to screen buffer
                pop     es
                mov     di,offset screen_buffer
                mov     ax,offset udr_vid2mem   ;call SCANREGION routine to
                mov     cx,window_start         ;  buffer the contents of
                mov     dx,window_end           ;  video memory
                call    scanregion
                call    openwindow              ;open printer menu window
                mov     al,hilite_attr          ;draw menu selection bar
                call    drawmenubar
;
;Monitor the keyboard for keystrokes and act upon the ones received.
;
keyloop:        mov     ah,0                    ;get a keystroke
                int     16h
                or      al,al                   ;branch on extended keycodes
                jz      functionkey
;
;Output control codes if ENTER was pressed.
;
                cmp     al,13                   ;check for ENTER keycode
                jne     escape
                call    outputlpt               ;output indexed control codes
                jmp     keyloop                 ;return to input loop
;
;Close the window and exit if ESC was pressed.
;
escape:         cmp     al,27                   ;check for ESC keycode
                jne     slash
                jmp     close                   ;jump to exit routines
;
;Jump down to the input line if the slash key was pressed.
;
slash:          cmp     al,"/"                  ;check for slash character
                jne     keyloop                 ;ignore anything else
                mov     al,menu_attr            ;blank the menu bar
                call    drawmenubar
                call    scanline                ;read input and send to LPT
                mov     al,hilite_attr          ;redraw the menu bar
                call    drawmenubar
                jmp     keyloop                 ;loop back for more
;
;Send the corresponding control codes if a function key was pressed.
;
functionkey:    cmp     ah,59                   ;determine whether or not a
                jb      keyloop                 ;  function key was pressed
                cmp     ah,68
                je      up_arrow
                push    ax                      ;save extended keycode
                mov     al,menu_attr            ;erase the menu bar
                call    drawmenubar
                pop     ax                      ;recover keycode
                sub     ah,59                   ;calculate new INDEX value
                mov     index,ah
                mov     al,hilite_attr          ;draw new menu bar
                call    drawmenubar
                call    outputlpt               ;output corresponding codes
                jmp     keyloop                 ;return to input loop
;
;Move the menu bar up one line if up-arrow was pressed.
;
up_arrow:       cmp     ah,72                   ;check for up-arrow
                jne     do_arrow
                mov     al,menu_attr            ;erase the menu bar
                call    drawmenubar
                dec     index                   ;decrement INDEX and wrap
                jns     newbar                  ;  if necessary
                mov     index,9
newbar:         mov     al,hilite_attr          ;redraw the menu bar
                call    drawmenubar
                jmp     keyloop                 ;return to input loop
;
;Move the menu bar down one line if down-arrow was pressed.
```

(continues)

SETUP2.ASM: *The assembly language source code for the SETUP2.COM utility that lets you control your printer's output from within an application program. SETUP2 may be used either from the command line or as a RAM-resident program.*

■ UTILITIES

```
;
dn_arrow:       cmp     ah,80                   ;check for down-arrow
                jne     pgup
                mov     si,menu_attr            ;arase the menu bar
                call    drawmenubar
                inc     index                   ;increment INDEX and wrap
                cmp     index,10                ;  around if necessary
                jne     newbar                  ;jump to finish up
                mov     index,0
                jmp     newbar
;
;Flip to the preceding menu page if PgUp was pressed.
;
pgup:           cmp     ah,72                   ;check for PgUp
                jne     pgdn
                cmp     pagecount,1             ;ignore if there is only
                je      retkey                  ;  one menu
                dec     menupage                ;set MENUPAGE to previous
                jns     newpage                 ;  page and wrap around
                mov     si,pagecount            ;  if necessary
                dec     si
                mov     menupage,al
newpage:        call    writemenu               ;write text of page to memory
                mov     al,hilite_attr          ;redraw the menu bar
                call    drawmenubar
retkey:         jmp     keyloop                 ;return to input loop
;
;Flip to the next page if PgDn was pressed.
;
pgdn:           cmp     ah,81                   ;check for PgDn
                jne     retkey
                cmp     pagecount,1             ;ignore if there is only
                je      retkey                  ;  one menu
                inc     menupage                ;adjust MENUPAGE
                mov     si,pagecount
                cmp     menupage,al
                jne     newpage                 ;jump to finish up
                mov     menupage,0
                jmp     newpage
;
;Close the menu window.
;
close:          mov     si,offset screen_buffer ;point SI to buffer
                mov     ax,offset cdr_mem2vio   ;call SCANREGION routine to
                mov     cx,window_start         ;  restore the contents of
                mov     dx,window_end           ;  video memory
                call    scanregion
;
;Restore the cursor mode and position, then exit.
;
restore:        mov     ah,2                    ;restore position
                mov     bh,videopage
                mov     dx,videocursorpos
                int     10h
                mov     ah,1                    ;restore mode
                mov     cx,videocursormode
                int     10h
                jmp     main_exit               ;return from interrupt
main            endp

;-------------------------------------------------------------------------
; SCANREGION scans the cursor over the indicated region and calls a
; user-defined routine at each stop.
;   Entry:  AX    - offset address of user-defined routine
;           CH,CL - upper left corner of region
;           DH,DL - lower right corner of region
;-------------------------------------------------------------------------
addr_udr        dw      ?                       ;routine address
columns         dw      0                       ;number of columns in region

scanregion      proc    near
                mov     addr_udr,ax             ;save address
                push    cx                      ;save starting cursor position
                sub     di,cl                   ;calculate number of columns
                inc     dl
                mov     byte ptr columns,dl
                sub     dh,ch                   ;calculate number of rows
                inc     dh
                mov     cl,dh
                xor     ch,ch
                pop     dx                      ;retrieve cursor position
                mov     bh,videopage            ;page number in BH
scanreg1:       push    cx                      ;save row counter
                push    dx                      ;save cursor position
                mov     cx,columns              ;load column counter
scanreg2:       mov     ah,2                    ;position cursor
                int     10h
                call    word ptr cs:[addr_udr]  ;call user-defined
                inc     dl                      ;  routine and
                loop    scanreg2                ;  advance the cursor
                pop     dx                      ;advance cursor to next row
                inc     dh                      ;  and loop until all rows
                pop     cx                      ;  are done
                loop    scanreg1
                ret
scanregion      endp

;-------------------------------------------------------------------------
; UDR_VIO2MEM is called by SCANREGION to save the contents of a screen area.
;   Entry:  ES:DI - buffer address
;-------------------------------------------------------------------------
udr_vio2mem     proc    near
                mov     ah,8                    ;get character and attribute
                int     10h                     ;  under the cursor
                stosw                           ;buffer them
                ret
udr_vio2mem     endp

;-------------------------------------------------------------------------
; UDR_MEM2VIO is called by SCANREGION to write to a screen area.
;   Entry:  DS:SI - buffer address
;-------------------------------------------------------------------------
udr_mem2vio     proc    near
                push    cx                      ;save CX
                lodsw                           ;get character and attribute
                mov     bl,ah                   ;attribute to BL
                mov     ah,9                    ;write character/attribute
                mov     cx,1
                int     10h
                pop     cx                      ;restore CX and exit
                ret
udr_mem2vio     endp

;-------------------------------------------------------------------------
; OPENWINDOW displays the printer control window.
;-------------------------------------------------------------------------
ftext           db      "1 2 3 4 5 6 7 8 9 10"
openwindow      proc    near
                mov     ax,0700h                ;blank window region
                mov     bh,menu_attr
                mov     cx,window_start
                mov     dx,window_end
                int     10h
                mov     cx,window_start         ;draw box around region to
                mov     dx,window_end           ;  form window border
                mov     bl,border_attr
                call    textbox
                mov     dx,window_start         ;display window title
                add     dx,0102h
                push    dx
                mov     si,offset pname
                mov     cx,26
                call    writeln
                pop     dx
                inc     dh
                push    dx                      ;draw first horizontal
                mov     cx,28                   ;  divider
                mov     bl,menu_attr
                call    drawhorizontal
                pop     dx
                inc     dh
                mov     cx,10                   ;draw "F1".."F10" designators
                mov     si,offset ftext
open1:          push    cx
                push    dx
                mov     ah,2
                int     10h
                mov     ax,0E46h
                int     10h
                inc     di
                mov     cx,2
                call    writeln
                pop     dx
                inc     dh
                pop     cx
                loop    open1
                push    dx                      ;draw second horizontal
                mov     cx,28                   ;  divider
                mov     bl,menu_attr
                call    drawhorizontal
                pop     dx
                inc     dh
                push    dx                      ;draw input line
                mov     al,hilite_attr
                mov     cx,28
                call    writeattr
                pop     dx
                inc     dh
                mov     si,offset menutxt       ;display menu line
                mov     cx,24
                call    writeln
                call    writemenu               ;display current menu
                ret
openwindow      endp

;-------------------------------------------------------------------------
; WRITELN displays a text string of known length.
;   Entry:  DS:SI - string address
;           DH,DL - starting row and column
;           CX    - string length
;-------------------------------------------------------------------------
writeln         proc    near
                mov     ah,2                    ;position cursor
                mov     bh,videopage
                int     10h
win1:           lodsb                           ;get a byte
                mov     ah,0Ah                  ;display it and advance the
                int     10h                     ;  cursor one column
                loop    win1                    ;loop until done
                ret
writeln         endp

;-------------------------------------------------------------------------
; TEXTBOX draws a box of specified color around a region.
;   Entry:  CH,CL - upper left corner row and column
;           DH,DL - lower right corner row and column
;           BL    - attribute
;-------------------------------------------------------------------------
wide            dw      0                       ;region width
height          dw      0                       ;region height
upleft          dw      ?                       ;upper left row and column

textbox         proc    near
                mov     upleft,cx               ;save coordinates
                sub     dh,ch                   ;calculate height
                dec     dh
                mov     byte ptr height,dh
                sub     dl,cl                   ;calculate width
                dec     dl
                mov     byte ptr wide,dl
                mov     bh,videopage            ;set BH for video calls
                mov     ah,2                    ;draw upper left corner
                mov     dx,upleft
                int     10h
                mov     ax,09DAh
                mov     cx,1
                int     10h
                inc     di                      ;draw top horizontal line
                mov     cx,wide
                call    drawhorizontal
```

(SETUP2.ASM continues)

```
                mov     ah,2                    ;draw upper right corner
                add     di,byte ptr wide
                int     10h
                mov     ax,09BFh
                mov     cx,1
                int     10h
                mov     ah,2                    ;draw lower left corner
                mov     dx,upleft
                add     dh,byte ptr height
                inc     dh
                int     10h
                mov     ax,09C0h
                mov     cx,1
                int     10h
                inc     dl                      ;draw bottom horizontal line
                mov     cx,wide
                call    drawhorizontal
                mov     ah,2                    ;draw lower right corner
                add     dl,byte ptr wide
                int     10h
                mov     ax,09D9h
                mov     cx,1
                int     10h
                mov     dx,upleft               ;draw left vertical
                inc     dh
                push    dx
                mov     cx,height
                call    drawvertical
                pop     dx
                add     dl,byte ptr wide        ;draw right vertical
                inc     dl
                mov     cx,height
                call    drawvertical
                ret
textbox         endp

;-----------------------------------------------------------------------
; DRAWHORIZONTAL draws a horizontal line of specified length.
;   Entry:  DH,DL - starting row and column
;           CX    - length
;           BL    - attribute
;-----------------------------------------------------------------------
drawhorizontal  proc    near
                mov     ah,2                    ;set cursor position
                mov     bh,videopage
                int     10h
                mov     ax,09C4h                ;draw line
                int     10h
                ret
drawhorizontal  endp

;-----------------------------------------------------------------------
; DRAWVERTICAL draws a vertical line of specified length.
;   Entry:  DH,DL - starting row and column
;           CX    - length
;           BL    - attribute
;-----------------------------------------------------------------------
drawvertical    proc    near
                mov     bh,videopage
vdraw1:         push    cx
                mov     ah,2                    ;position cursor
                int     10h
                mov     ax,0983h                ;draw one character
                mov     cx,1
                int     10h
                inc     dh                      ;move cursor to next line
                pop     cx
                loop    vdraw1                  ;loop until done
                ret
drawvertical    endp

;-----------------------------------------------------------------------
; WRITEMENU displays a page of menu text.
;   Entry:  MENUPAGE - menu page number
;-----------------------------------------------------------------------
writemenu       proc    near
                mov     al,menupage             ;point SI to menu text
                mov     bl,200
                mul     bl
                mov     si,ax
                add     al,offset menu_table
                mov     ax,0600h                ;blank current menu
                mov     bh,menu_attr
                mov     cx,window_start
                add     cx,0300h
                push    cx
                mov     dx,cx
                add     dx,0513h
                int     10h
                pop     dx
                mov     cx,18                   ;determine how many lines are
                mov     al,pagecount            ;  to be written
                dec     al
                cmp     al,menupage
                jne     wmloop
                mul     ten
                mov     cx,linecount
                sub     cx,ax
                jcxz    nomenu
wmloop:         push    cx                      ;save line counter
                push    dx                      ;save cursor position
                mov     ca,28                   ;display one line of menu text
                call    writelo
                pop     dx                      ;advance cursor to next line
                inc     dh
                pop     cx
                loop    wmloop                  ;loop until done
nomenu:         ret
writemenu       endp

;-----------------------------------------------------------------------
; WRITEATTR writes a series of attribute bytes to video memory.  Writing is
; performed during the vertical retrace on color adapters.
;   Entry:  AL    - attribute
;           CX    - number of attributes to write
;           DH,DL - starting row and column
;-----------------------------------------------------------------------
writeattr       proc    near
                push    ax                      ;save attribute
                mov     al,videocols            ;calculate address of the
                mul     dh                      ;  indicated character cell
                xor     dh,dh                   ;  in video memory
                add     ax,dx
                shl     ax,1
                add     ax,videostart
                mov     di,ax
                inc     di
                mov     ax,videoseg             ;point ES to video memory
                cmp     videoseg,0B800h         ;don't wait if display
                je      nowait                  ;  is monochrome
                mov     dx,3DAh                 ;address CRTC status register
wait_for_vert:  in      al,dx                   ;wait for vertical retrace
                test    al,8
                je      wait_for_vert
nowait:         pop     ax                      ;retrieve attribute
attrloop:       stosb                           ;write attributes
                inc     di
                loop    attrloop
                ret
writeattr       endp

;-----------------------------------------------------------------------
; DRAWMENUBAR draws or erases the menu selection bar.
;   Entry:  AL    - attribute
;           INDEX - selection index number
;-----------------------------------------------------------------------
drawmenubar     proc    near
                mov     dx,window_start         ;calculate starting row and
                add     dh,index                ;  column
                add     dx,0302h
                mov     cx,20                   ;20 character cells to alter
                call    writeattr               ;write the attribute bytes
                ret
drawmenubar     endp

;-----------------------------------------------------------------------
; SCANLIGX reads an input string from the keyboard, converts ASCII numbers
; to binary, and sends them to the designated printer port.
;-----------------------------------------------------------------------
input_pos       dw      ?                       ;row and column of input line

nameline        proc    near
                push    cs                      ;point ES:DI to input buffer
                pop     es
                mov     di,offset input_buffer
                mov     dx,window_start         ;position the cursor
                add     dx,0E02h
                mov     input_pos,dx            ;save coordinates
                mov     ah,2
                mov     bh,videopage
                int     10h
                mov     ah,1                    ;unblank the cursor
                mov     cx,cursor_def
                int     10h
                xor     cl,cl                   ;zero character count
;
;Read and buffer keystrokes until ENTER or ESC is pressed.
;
scanloop:       mov     ah,0                    ;wait for a keystroke
                int     16h
                cmp     al,0                    ;check for backspace
                jne     scan1
                or      cl,cl                   ;ignore backspace if count
                je      scanloop                ;  is zero
                call    backspace               ;perform backspace
                jmp     scanloop                ;return to input loop
scan1:          cmp     al,13                   ;branch if ENTER pressed
                je      endscan
                cmp     al,27                   ;branch if ESC pressed
                je      esckey
                cmp     al,32                   ;ignore control codes
                jb      scanloop
                cmp     cl,255                  ;ignore the character if
                je      scanloop                ;  input buffer is full
                call    insert_char             ;buffer the character
                jmp     scanloop                ;return to input loop
;
;Parse the text just entered and output binary codes to the printer.
;
endscan:        mov     es:[di],al              ;buffer EOL character
                push    bx                      ;save registers
                push    cx
                push    di
                mov     si,offset input_buffer  ;point SI to text
                mov     di,offset output_buffer ;point DI to output buffer
                call    asc2hin                 ;convert ASCII to binary
                jnc     checkstat               ;continue if no error
                mov     si,offset errtxt1       ;display error message if
scan2:          call    win_error               ;  code string is invalid
                pop     di                      ;restore registers
                pop     cx
                pop     bx
                jmp     scanloop                ;return to input loop
checkstat:      call    lptstatus               ;check printer status
                jnc     scan3                   ;continue if printer ready
                mov     si,offset errtxt2       ;display error message
                jmp     scan2
scan3:          mov     al,offset output_buffer ;point SI to codes
                call    sendlptcodes            ;output them
                add     sp,8                    ;clean up the stack
;
;Clear the input line and exit.
;
esckey:         mov     ah,1                    ;blank the cursor
                mov     ch,20h
                int     10h
                mov     ah,2                    ;position cursor at input line
                mov     dx,input_pos
                mov     bh,videopage
                int     10h
                mov     ax,0A20h                ;blank the input line
```

(SETUP2.ASM continues)

■ UTILITIES

```
                mov     cx,25
                int     10h
                ret                             ;and exit
scanline        endp

;-----------------------------------------------------------------------
; BACKSPACE deletes the character left of the cursor.
;-----------------------------------------------------------------------
bsckspace       proc    near
                dec     cl                      ;decrement character count
                dec     di                      ;decrement buffer pointer
                cmp     si,24                   ;branch if count > 24
                ja      refresh
                push    cx                      ;save character count
                mov     ah,0Eh                  ;move the cursor back one
                int     10h                     ;  space
                mov     ax,0A20h                ;overwrite character under the
                mov     cx,1                    ;  cursor with a space
                int     10h
                pop     cx                      ;restore count
                ret
refresh:        push    cx                      ;save character count
                mov     si,di                   ;scroll the input line one
                sub     si,25                   ;  character to the right to
                mov     cx,25                   ;  blank the last character
                mov     dx,input_pos
                call    writeln
                pop     cx                      ;restore count
                ret
backspace       endp

;-----------------------------------------------------------------------
; INSERT_CHAR inserts a character into the input buffer.
;-----------------------------------------------------------------------
insert_char     proc    near
                stosb                           ;buffer the character
                inc     cl                      ;increment character count
                cmp     cl,25                   ;branch if count > 25
                ja      refresh
                mov     ah,0Eh                  ;display the character
                int     10h
                ret
insert_char     endp

;-----------------------------------------------------------------------
; ASC2BIN converts an ASCII text string into a string of binary bytes.
;   Entry:  DS:SI - text string address
;           ES:DI - binary buffer address
;   Exit:   CF clear = no errnr, CF set = error
;           CL = number of codes converted
;-----------------------------------------------------------------------
asc2bin         proc    near
                push    di                      ;save count byte address
                inc     di                      ;advance past count byte
                xor     cl,cl                   ;zero count
                xor     bh,bh                   ;zero BH
a2bloop:        mov     dx,0A00h                ;initialize DH (base) and
                                                ;  DL (accumulator)
;
;Search until the first character of an entry or EOL marker is encountered.
;
nextchar:       lodsb                           ;get a character
                call    check_20_2c             ;skip spaces, commas, and tabs
                jz      nextchar
                cmp     al,0Dh                  ;done if EOL encountered
                je      endconvert
                cmp     al,"/"                  ;done if slash encountered
                je      endconvert
                call    check_22_27             ;check for " or ' mark
                jnz     isdigit                 ;branch if neither
;
;Buffer everything between quotation marks or apostrophes.
;
inquotes:       lodsb                           ;get next character
                call    check_22_27             ;exit loop if ending quote
                jz      nextchar                ;  symbol is encountered
                cmp     al,0Dh                  ;exit if line terminator is
                je      endconvert              ;  is encountered
                stosb                           ;buffer the character
                inc     cl                      ;increment count
                jz      a2berror                ;error if count > 255
                jmp     inquotes                ;loop back for more
;
;Convert a numeric entry to binary.
;
digitloop:      lodsb                           ;get next character
                call    check_20_2c             ;check for delimiter marking
                jz      endnumtext              ;  end of the current number
                call    check_22_27
                jz      endnumtext
                cmp     al,0Dh                  ;check for end-of-line
                je      endnumtext
isdigit:        cmp     al,30h                  ;digit is valid if it lies
                jb      a2berror                ;  between "0" and "9"
                cmp     al,3Ah
                jb      aarii adjust
                and     al,0DFh                 ;capitalize presumed alpha
                cmp     al,"S"                  ;change base to 16 for hex
                jne     check_hex               ;  numbers if "S" is found
                mov     dh,16
                jmp     digitloop
check_hex:      cmp     dh,16                   ;error if this isn't base 16
                jne     a2berror
                cmp     al,41h
                jb      a2berror                ;digit is valid if it lies
                cmp     al,46h                  ;  between "A" and "F"
                ja      a2berror
                sub     al,7                    ;hex conversion
ascii_adjust:   sub     al,30h                  ;ASCII to binary conversion
                mov     bl,al                   ;save digit
                mov     al,dl                   ;multiply accumulator by base
                mul     dh
                add     ax,bx                   ;add new digit to result
                or      ah,ah                   ;error if result > 255
                jnz     a2berror
                mov     dl,al                   ;put new value in accumulator
                jmp     digitloop               ;get next digit
a2berror:       pop     bx                      ;clean up the stack
                xor     cl,cl                   ;zero CX as error
                mov     es:[bx],cl              ;store zero in buffer
                stc                             ;set CF for error
                ret
endnumtext:     mov     al,dl                   ;write accumulator value to
                stosb                           ;  binary buffer
                inc     cl                      ;increment count
                js      a2berror                ;error if count > 255
                dec     si                      ;point SI to terminator
                jmp     a2bloop                 ;search for next number
;
;Do housekeeping and exit.
;
endconvert:     pop     bx                      ;recover count byte address
                mov     es:[bx],cl              ;store count in buffer
                clc                             ;clear CF for exit
                ret
asc2bin         endp

;-----------------------------------------------------------------------
; CHECK_20_2C returns a flag if AL holds an ASCII space, comma, or tab.
;   Entry:  AL = character
;   Exit:   ZF clear = no match, ZF set = space or comma
;-----------------------------------------------------------------------
check_20_2c     proc    near
                cmp     al,20h                  ;check for ASCII space
                ja      ischar1
                cmp     al,2Ch                  ;check for ASCII comma
                ja      ischar1
                cmp     al,9                    ;check for ASCII tab
ischar1:        ret
check_20_2c     endp

;-----------------------------------------------------------------------
; CHECK_22_27 returns a flag if AL holds an ASCII quote mark or apostrophe.
;   Entry:  AL = character
;   Exit:   ZF clear = no match, ZF set = space or comma
;-----------------------------------------------------------------------
check_22_27     proc    near
                cmp     al,22h                  ;check for quotation mark
                ja      ischar2
                cmp     al,27h                  ;check for apostrophe
ischar2:        ret
check_22_27     endp

;-----------------------------------------------------------------------
; LPTSTATUS checks the status of the indicated printer.
;   Entry:  LPT_NUMBER - printer number (0-2)
;   Exit:   CF clear = printer ready, CF set = printer not ready
;-----------------------------------------------------------------------
lptstatus       proc    near
                mov     ah,2                    ;get status byte from BIOS
                mov     dx,lpt_number
                int     17h
                test    ah,29h                  ;check bits 0, 3, and 5
                jnz     notready                ;error if one is set
                test    ah,0F9h                 ;check all but bits 1 and 2
                jz      notready                ;error if all are zero
                clc                             ;clear CF for return
                ret
notready:       stc                             ;set CF for return
                ret
lptstatus       endp

;-----------------------------------------------------------------------
; SENDLPTCODES sends a string of bytes to the designated printer.
;   Entry:  DS:SI     - string (first byte = length)
;           LPT_NUMBER - printer number (0-2)
;-----------------------------------------------------------------------
sendlptcodes    proc    near
                lodsb                           ;get string length in CX
                mov     cl,al
                mov     ch,ch
                jcxz    nosend                  ;exit if length is zero
                mov     dx,lpt_number           ;initialize DX
sendloop:       lodsb                           ;loop until all bytes are
                mov     ah,0                    ;  output
                int     17h
                loop    sendloop
nosend:         ret
sendlptcodes    endp

;-----------------------------------------------------------------------
; OUTPUTLPT sends the string of control codes indexed by INDEX and MENUPAGE
; to the printer designated by LPT_NUMBER.
;-----------------------------------------------------------------------
outputlpt       proc    near
                call    lptstatus               ;check printer status
                jnc     isready
                mov     si,offset errtxt2       ;error if printer is not
                call    win_error               ;  ready
no_output:      ret
isready:        mov     si,menupage             ;calculate offset address
                mul     ten                     ;  of control code string
                add     al,index                ;  from MENUPAGE and INDEX
                cmp     am,linecount            ;make sure a control code
                jae     no_output               ;  string is defined
                mov     cx,am
                mov     si,code_table           ;find offset address of the
                jcxz    nocalc                  ;  corresponding code string
notloop:        mov     al,[si]                 ;  by scanning the linked
                inc     si                      ;  list of control codes
                add     si,ax
                loop    notloop
nocalc:         call    sendlptcodes            ;output the code string
                ret
outputlpt       endp

;-----------------------------------------------------------------------
; WIN_ERROR displays an error message and waits for a keystroke.
;   Entry:  DS:SI - text address
;-----------------------------------------------------------------------
menutxt         db      "Esc Enter /*,20h,18h,19h,26h,"PgUp PgDn"
```

(SETUP2.ASM continues)

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CIRCLE 331 ON READER SERVICE CARD

■ UTILITIES

```
errtxt1         db      "Error: Invaiid entry",4 dup (20h)
errtxt2         db      "Error: Printer not ready"

eln_error       proc    near
                call    disp_err_msg            ;display error message
                mov     ax,0E07h                ;beep
                int     10h
eiol:           mov     ah,1                    ;loop until a key is
                int     16h                     ;  pressed
                je      wioi
                mov     si,offset menutxt       ;restore original text
                call    disp_err_msg
                ret
eln_error       endp

;---------------------------------------------------------------------------
; DISP_ERR_MSG displays a window error message.
;   Entry:  DS:SI = text address
;---------------------------------------------------------------------------
disp_err_msg    proc    near
                mov     ah,3                    ;get cursor position
                mov     bh,videopage
                int     10h
                push    dx                      ;save it
                mov     dx,window_start         ;display error message
                add     dx,0F02h
                mov     ce,24
                call    writeln
                mov     ah,2                    ;restore cursor position
                pop     dx
                int     10h
                ret
disp_err_msg    endp

;===========================================================================
; INITIALISE handles command line directives and installation/deinstallation.
;---------------------------------------------------------------------------
errmsgi         db      "Usage: SETUP2 [d:][path][filename] | [/C codes] |
[/U]$"
errmsg2         db      "Already installed$"
errmsg3         db      "Cannot uninstall$"
errmsg4         db      "Not installed$"
errmsg6         db      "Invalid code string$"
errmsg7         db      "Printer not ready$"
errmsg8         db      "File not found$"
errmsg9         db      "File too large$"
errmsg10        db      "Insufficient memory$"
errmsg11        db      "Make file error - line $"
initmsgi        db      "Uninstalled$"
installed       db      0

initialise      proc    near
                assume  cs:code, dx:code

;
;See if a copy is already resident in memory.
;
                cld                             ;clear DF
                mov     word ptr [begin],0      ;initialise fingerprint
                xor     bx,bx                   ;zero BX for start
                mov     ax,cs                   ;keep CS value in AX
initl:          inc     bx                      ;increment search segment value
                mov     es,bx
                cmp     ax,bx                   ;not installed if current
                je      parse                   ;  segment is looped back to
                mov     si,offset begin         ;search this segment for ASCII
                mov     di,si                   ;  fingerprint
                mov     cx,14
                repe    cmpsb
                jne     initl                   ;loop back if not found
                mov     installed,1             ;set installed flag

;
;Parse the command line for entries and take appropriate action.
;
parse:          mov     si,81h                  ;point SI to command line
parseloop:      lodsb                           ;get a character
                cmp     al,20h                  ;skip it if it's a space
                je      parseloop
                cmp     al,0Dh                  ;exit loop when a carriage
                jne     init2                   ;  return is encountered
                jmp     installl
init2:          cmp     al,'/'                  ;check for "/" modifier
                je      init3                   ;branch if found
                mov     dx,offset errmsg2       ;initialise error pointer
                cmp     installed,0             ;check installed flag
                jne     error_exit              ;error if already installed
                dec     si                      ;point SI to filename
                call    make                    ;process printer make file
                jmp     setvec                  ;install
init3:          lodsb                           ;get parameter
                and     al,0DFh                 ;capitalize
                cmp     al,"U"                  ;branch to handling routine
                je      deinstall
                cmp     al,"C"
                je      readcodes

;
;An error was encountered in parsing.  Display error message and exit.
;
syntax_error:   mov     dx,offset errmsgi       ;display error message
error_exit:     mov     ah,0
                int     21h
                mov     ax,4C01h                ;exit with ERRORLEVEL = 1
                int     21h

;
;Process a /U command line parameter.
;
deinstall:      mov     dx,offset errmsg4       ;error if not installed
                cmp     installed,1
                jne     error_exit
                call    remove                  ;call deinstall routine
                mov     dx,offset errmsg3       ;exit on error
                jc      error_exit
                mov     dx,offset initmsg1      ;display "Uninstalled"
                mov     ah,9                    ;  message
                int     21h
                mov     ax,4C00h                ;exit with ERRORLEVEL = 0
                int     21h

;
;Process a /C command line parameter.
;
readcodes:      push    cs                      ;set ES to code segment
                pop     es
                mov     di,offset menu_table    ;point DI to scratch area
                call    asc2hin                 ;convert text to binary
                mov     dx,offset errmsg6       ;exit on conversion error
                jc      error_exit
                or      cl,cl                   ;exit if no codes were entered
                je      error_exit
                call    lptstatus               ;check printer status
                mov     dx,offset errmsg7
                jc      error_exit              ;error if printer not ready
                mov     si,offset menu_table    ;point SI to output buffer
                call    sendlptcodes            ;output control codes
read_exit:      mov     ax,4C00h                ;exit with ERRORLEVEL = 0
                int     21h

;
;Make sure a copy isn't already loaded before installing this one.
;
install:        mov     dx,offset errmsg2       ;initialise error pointer
                cmp     installed,0             ;check installed flag
                jne     error_exit              ;error if already installed

;
;Reset the interrupt 9h vector to an interrupt handler.
;
setvec:         mov     ax,3509h                ;save old vector
                int     21h
                mov     word ptr int9h,bx
                mov     word ptr int9h[2],es
                mov     ax,2509h                ;then set the new vector
                mov     dx,offset kbint
                int     21h

;
;Deallocate the program's environment block.
;
                mov     ax,ds:[2Ch]             ;get environment segment
                mov     es,ax
                mov     ah,49h                  ;free it
                int     21h

;
;Display copyright notice, then terminate and remain resident in memory.
;
                mov     ah,9                    ;display message
                mov     dx,offset progrm
                int     21h
                mov     ax,3100h                ;terminate with ERRORLEVEL = 0
                mov     dx,end_offset           ;calculate amount of memory
                sub     dx,offset code - 15     ;  to reserve in DX
                mov     cl,4                    ;convert bytes to paragraphs
                shr     dx,cl
                int     21h                     ;terminate
initialise      endp

;---------------------------------------------------------------------------
; REMOVE deallocates the memory block addressed by ES and restores the
; interrupt vector displaced on installation.
;   Entry:  ES = segment to release
;   Exit:   CF clear = program uninstalled
;           CF set   = can't uninstall
;---------------------------------------------------------------------------
remove          proc    near
                mov     ax,es                   ;abort if the interrupt 9
                mov     ax,3509h                ;  vector has been altered
                int     21h                     ;  since installation
                mov     ax,es
                cmp     ax,cs
                jne     remove_error
                mov     ax,es
                mov     ah,49h                  ;free memory given to
                int     21h                     ;  original program block
                jc      remove_error            ;branch on error
                push    ds                      ;restore interrupt vector
                assume  dx:nothing
                mov     ax,2509h
                ldx     dx,es:[int9h]
                int     21h
                pop     ds
                assume  dx:code
                not     word ptr es:[begin]     ;destroy ASCII fingerprint
                clc                             ;clear CF for exit
                ret
remove_error:   stc                             ;set CF to indicate program
                ret                             ;  couldn't be uninstalled
remove          endp

;===========================================================================
; MAKE reads a make file and builds the program's menu and code tables.
;---------------------------------------------------------------------------
handle          dw      ?                       ;file handle
filesize        dw      ?                       ;file size in bytes
filebeg         dw      ?                       ;file buffer segment

make            proc    near
                mov     dx,si                   ;save address of first char
make1:          lodsb                           ;find end of filename
                cmp     al,0Dh
                je      make2
                cmp     al,20h
                jne     make1
make2:          mov     byte ptr [si-1],0       ;convert filename to ASCIIZ

;
;Open the printer make file and read it into memory.
;
                mov     ax,3D00h                ;open the make file
                int     21h
                mov     dx,offset errmsg9       ;error if call failed
                jc      make_error2
                mov     handle,ax               ;save file handle
                mov     bx,ax                   ;determine the file's size
                mov     ax,4202h                ;  in bytes
                xor     cx,cx
                xor     dx,dx
                int     21h
```

(SETUP2.ASM continues)

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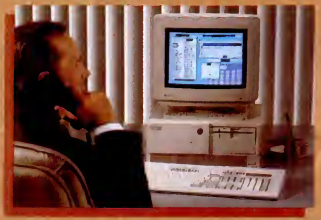
```
                or      dx,dx                   ;error if greater than 64K
                je      make3
make_error1:    mov     dx,offset errmsg9
make_error2:    jmp     error_exit
make3:          cmp     ax,0f7f0d8
                ja      make_error1
                mov     filesize,ax             ;save file size
                mov     eh,4Ah                  ;shrink memory allocation
                mov     bx,1000h                ;  to 64K
                push    cs
                pop     es
                int     21h
                mov     dx,offset errmsg10      ;insufficient memory if
                jo      make_error2             ;  call failed
                mov     ah,48h                  ;request enough additional
                mov     bx,filesize             ;  memory to read in the
                add     bx,10                   ;  make file
                mov     cl,4
                shr     bx,cl
                int     21h
                mov     dx,offset errmsg10      ;insufficient memory if
                jo      make_error2             ;  call failed
                mov     filseeg,ax              ;save segment address
                mov     ax,4200h                ;reset file pointer
                mov     bx,handle
                xor     cx,cx
                xor     dx,dx
                int     21h
                mov     ah,3Fh                  ;read make file into the
                mov     bx,handle               ;  portion of memory just
                mov     cx,filesize             ;  allocated
                xor     dx,dx
                assume  ds:nothing
                mov     ds,filseeg
                int     21h
                mov     ah,3Eh                  ;close the file
                mov     bx,handle
                int     21h
                mov     bx,filesize             ;find the end of the file
                cmp     byte ptr [bx-1],1Ah     ;delete last character if it
                jne     make4                   ;  is a Ctrl-Z
                dec     bx
make4:          cmp     word ptr [bx-2],0A0Dh   ;add a carriage return/
                je      make5                   ;  line feed pair if the
                mov     word ptr [bx],0A0Dh     ;  file doesn't already
                add     bx,2                    ;  end with one
make5:          mov     byte ptr [bx],0         ;write terminating zero
```

```
;
;Copy the printer name from the printer make file.
;
                push    cs                      ;initialize DS:SI to address
                pop     ss                      ;  file buffer and ES:DI to
                xor     si,si                   ;  address printer name
                mov     di,offset pname         ;  string
pname1:         call    skip_comment            ;skip comment lines
pname2:         cmp     byte ptr [si],0         ;exit if EOF is reached
                jne     pname3
                jmp     make_exit
pname3:         mov     cx,28
pname4:         lodsh                           ;get a character
                cmp     el,0Dh                  ;quit now if the character is
                jne     pname5                  ;  a carriage return
                inc     si
                jmp     short extract_text
pname5:         stosh                           ;otherwise copy the character
                loop    pname4                  ;copy up to 28 characters
                call    nextline                ;advance to start of next line
;
;Extract the menu text entries from the printer make file.
;
extract_text:   mov     di,offset menu_table    ;initialize DI
                push    si                      ;save starting address
text1:          call    skip_comment            ;skip comment lines
text2:          cmp     byte ptr [si],0         ;exit if EOF is reached
                je      extract_codes
                mov     cx,28
text3:          lodsh                           ;get a character
                cmp     el,0Dh                  ;finish this line and proceed
                ja      text3                   ;  to the next if a semicolon
                cmp     el,";"                  ;  or carriage return is
                je      text4                   ;  encountered
                stosh                           ;copy the character
                loop    text3                   ;loop back for another
text4:          call    add_spaces              ;pad text with spaces
                inc     linecount               ;register the entry
                call    nextline                ;find start of next line
                jmp     text1
text5:          call    add_spaces              ;pad text with spaces
                inc     linecount               ;register the entry
                inc     si                      ;advance SI to start of
                jmp     text1                   ;  next line
;
```

(SETUP2.ASM continues)

MP386

MP286



MP386s

mp286L

```
;Extract the control codes from the printer make file.
;
extract_codes:  mov     code_table,di           ;save code table address
                pop     si                      ;point SI to first line
                mov     cs,linecount            ;initialize line counter
                jcxz    calc_pages              ;skip if no lines
codes1:         call    skip_comment            ;skip comment lines
codes2:         lodsb                           ;get a character
                cmp     al,0Dh                  ;error if carriage return is
                je      code_error              ;  found before semicolon
                cmp     al,";"                  ;loop back for another if this
                jne     codes2                  ;  one isn't a semicolno
                push    cx                      ;if a semicolno was found, call
                call    asc2bin                 ;  ASC2BIN to convert the text
                pop     cx                      ;  string that follows to
                jc      code_error              ;  to binary
                inc     si                      ;advance SI to next line
                loop    codes1                  ;loop until all lines are done
;
;Calculate the number of menu pages.
;
calc_pages:     push    cs                      ;restore DS
                pop     ds
                assume  ds:code
                mov     end_offset,di           ;save ending address
                mov     ax,linecount            ;exit now if there are
                or      ax,ax                   ;  no entries
                je      make_exit
                dec     ax                      ;calculate number of menu
                div     ten                     ;  pages
                inc     al
                mov     pagecount,al            ;store count in PAGECOUNT
make_exit:      mov     ah,49h                  ;free memory allocated for
                mov     es,fileseg              ;  the file buffer
                int     21h
                ret
;
;Display the line number where a make error occurred, then exit.
;
code_error:     push    cs                      ;reset DS
                pop     ds
                mov     ah,9                    ;display error message
                mov     dx,offset errmsg11
                int     21h
                mov     ax,linecount            ;display line number
                call    bin2asc
                mov     ax,4c01h                ;exit with ERRORLEVEL = 1
                int     21h
make            endp

;-----------------------------------------------------------------------
; BIN2ASC converts a binary value in AX to ASCII and displays it.
;-----------------------------------------------------------------------
bin2asc         proc    near
                mov     bx,10                   ;initialize divisor word and
                xor     cx,cx                   ;  digit counter
b2a1:           inc     cx                      ;increment digit count
                xor     dx,dx                   ;divide by 10
                div     bx
                push    dx                      ;save remainder on stack
                or      ax,ax                   ;loop until quotient is zero
                jne     b2a1
b2a2:           pop     dx                      ;retrieve a digit from stack
                add     dl,30h                  ;convert it to ASCII
                mov     ah,2                    ;display it
                int     21h
                loop    b2a2                    ;loop until done
                ret
bin2asc         endp

;-----------------------------------------------------------------------
; ADD_SPACES pads a menu text string with space characters.
;-----------------------------------------------------------------------
add_spaces      proc    near
                jcxz    add_exit
                mov     al,20h
                rep     stosb
add_exit:       ret
add_spaces      endp

;-----------------------------------------------------------------------
; SKIP_COMMENT advances SI to the first non-comment line.
;-----------------------------------------------------------------------
skip_comment    proc    near
                cmp     byte ptr [si],"@"
                jne     skip_exit
                call    nextline
                jmp     skip_comment
skip_exit:      ret
skip_comment    endp
```

(SETUP2.ASM continues)

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```
;-------------------------------------------------------------------------
; NEETL3NE advances BI to the beginning of the next line.
;-------------------------------------------------------------------------
nextline        proc    near
                lodsb
                cmp     al,0DA
                jne     nextline
                inc     si
                ret
nextline        endp

;=========================================================================
; Buffer areas used after installation.
```

```
;=========================================================================
ps              =       6
screen_buffer   =       ps
pc              =       ps + 1828
input_buffer    =       ps
pc              =       ps + 256
output_buffer   =       pc
ps              =       ps + 286
menu_table      =       pc

code            ends
                end     begin
```

(SETUP2.ASM ends)

```
100 REM - BASIC PROGRAM TO CREATE SETUP2.COM
110 CLS:PRINT "Creating SETUP2.COM   ": OPEN "SETUP2.COM  " AS #1 LEN = 1
120 FIELD #1, 1 AS A$: CHECKSUM=0
130 FOR I = 1 TO   168
140  LIBSSUB4=8: LOCATE 2,2: PRINT "Countdown: "   168 - 3 ;
150   FOR J = 1 TO  16: READ BYTE$: BYTE = VAL("&H" + BYTE$)
160    CHECKSUB$ = CHECKSUM$ + BYTE: LIBSEBUB$ = LIBSSUB$ + BYTE
170    IF (BYTE < 256) THEN LSET A$=CHR$(BYTE): PUT #1
180   NEXT J
190   READ L3NETOT$: L3SECHECK$ = VAL("&H"+L3NETOT$)
200   IF LIBSCSECB$ = LIBSSUB$ THEN GOTO 220
210   LOCATE 4,2: PRINT "Error in line #"  ;   268 +   18 * 3: GOTO 268
220 NEXT 3
230 CLOSE: READ 63LETOT$ : 63LSECECK$ = VAL(63LETOT$)
240 IF CHECKSUB$ <> F3LECHECK$ THEN GOTO 260
250 PRINT: PRINT "SETUP2.COM   created successfully": BYTEN
260 PRINT: PRINT "SETUP2.COM    is not valid!": END
270 DATA 89, B2,  7, 52, 45, 54, 55, 50, 20, 22, 2E, 20, 28, 20, 62, 29,   4B7
280 DATA 20, 21, 29, 20, 29, 20, 5A, 69, 66, 66, 20, 43, 6F, 6D, 6D, 75,   4CB
290 DATA 6B, 69, 62, 61, 74, 69, 6F, 6E, 73, 20, 42, 66, 2E,  D,  A, 98,   526
300 DATA 43, 28, 4D, 61, 67, 61, 7A, 69, 6B, 65, 20, FE, 28, 4A, 45, 66,   5E2
310 DATA 66, 28, 50, 72, 6F, 73, 69, 72, 65,  D,  A, 48, 6F, 74, 6B, 65,   57D
320 DATA 79, 20, 69, 72, 20, 43, 74, 72, 6C, 2D, 52, 74, 2F, 52, 6B, 65,   570
330 DATA 66, 74,  D,  A, 24, 1A,  8,  0,  8,  0,  8,  0,  8,  0,  0,  0,   I2F
340 DATA 20, 20, 20, 20, 20, 20, 20, 20, 20, 20, 20, 20, 20, 20, 20, 20,   200
350 DATA 20, 20, 20, 20, 20, 20, 20, 20, 20, 20,  0,  0,  0,  0,  0,  0,   140
360 DATA  0,  0,  1,  0,  0,  0,  0,  0,  0,  0,  0,  A,  0,  0,  1,  0,     C
370 DATA 78, 11, 78, 11, 9C, 2E, FF, 1B, 8D,  1, FE, 58, E4,  2, CD, 16,   66E
380 DATA 24,  6, 3C,  5, 58, 75,  B, 2E, 88, 2E, 8C,  1,  0, 78,  3, E8,   425
390 DATA  1,  0, CF, 2B, C6,  6, 8C,  1,  1, 90, 92, 51, 52, 55, 56, 57,   4A0
400 DATA 1E,  6, B4,  F, CD, 10, 3C,  7, 74, 14, 3C,  4, 72, 10,  7, 1F,   377
410 DATA 9F, 9B, 5D, 5A, 59, 5B, 58, 2B, C6,  6, 8C,  1,  0, C3,  B, 1F,   4F7
420 DATA FC, 88, 26, 66,  1, 88, 2E, 67,  1, E4,  2, CD, 10, 89,  B, 6C,   5D6
430 DATA  1, 89, 16, 6B,  1, E8, 48,  0, 8E, C0, 26, 8B, 16, 4E,  0, 89,   462
440 DATA 16, 6A,  1, 26, 66,  6, 63,  0, 48, 75, 1D, C7,  6, 6B,  1,  0,   48B
450 DATA E8, C6,  0, 55,  1, 7B, C6,  6, 56,  1,  7, C6,  6, 57,  1, 7B,   5C0
460 DATA C7,  6, 9B,  1,  D,  C, BB, 1B, C7,  6, 6B,  1,  0, E8, C6,  6,   526
470 DATA 95,  1, 7B, C6,  6, 9C,  1, 4F, C6,  6, 57,  1, 7B, C7,  6, 9B,   561
480 DATA  1,  7,  6, B4,  1, B5, 20, CD, 10, 8A,  B, 66,  1, 8B, B9, 2B,   4FD
490 DATA 8B,  B, 91,  1, 8A, 2B, 92,  1, 8B, D1, 81, C2, 1D, 1B, 89, 16,   5DB
500 DATA 92,  1, E,  7, E6, 7C,  B, E8, B6,  3, 8B,  B, 61,  1, 8B, 16,   935
510 DATA 92,  1, E8,  7,  1, B8, 5B,  1, A8, 97,  1, E8, 26,  2, B4,  8,   5C8
520 DATA D3, 16,  A, C8, 74, 25, 3C,  D, 75,  5, B8, B8,  4, BB, BF, 3C,   6C3
530 DATA 1B, 75,  2, E6, BA,  8, 3C, 2F, 75, B4, A8, B6,  1, B8,  4,  3,   620
540 DATA B8, 16,  2, A8, 67,  1, E8, F8,  2, EB, D3, 80, FC, 3B, 73, CB,   8D2
550 DATA 48, FC, 44, 77, 1A, 58, A8, 96,  1, E8, E8,  2, 58, 88, EC, 2B,   7A6
560 DATA 86, 26, 6A,  1, A8, 67,  1, E8, DA,  2, 8B, 16, 4E,  0, BB, AF,   7C3
570 DATA FC, 48, 75, 16, A8, 56,  1, E8, CA,  2, FE,  B, 6A,  1, 76,  5,   6B3
580 DATA C6,  6, 6A,  1,  5, A8, 57,  1, E8, E5,  2, EE, 51, 88, 6C, 58,   762
590 DATA 75, 18, A8, 56,  1, B8, AC,  2, 6B,  6, 5A,  1, 88, 3E, 6A,  1,   652
600 DATA  A, 75, E2, C6,  6, 5A,  1,  0, EE, DE, 88, FC, 45, 75, 21, 88,   766
610 DATA 2B, 5B,  1,  1, 74, 17, FE,  B, 6F,  1, 76,  0, A8, 5E,  1, FE,   5D2
620 DATA C8, A2, 6F,  1, B8,  1,  2, A8, 67,  1, E8, 77,  2, E6, 4E, FF,   7C4
630 DATA 88, FC, 51, 75, F8, B8, 2B, 6B,  1,  1, 74, F1, 6E,  6, 6F,  1,   7A1
640 DATA A8, 6B,  1, 38,  6, 9F,  1, 75, D8, C6,  6, 9F,  1,  0, BB, D4,   660
650 DATA BB, 7C,  B, B8, C5,  3, 8B,  B, 91,  1, 4B, 16, 93,  1, 8B, 1E,   630
660 DATA  8, B4,  2, BA, 20, 67,  1, 6B, 16, 6B,  1, CD, 10, B4,  1, 8B,   512
670 DATA E, 6C,  1, CD, 10, E5, 56, FE,  8,  8,  8,  0, A2, 88,  2, 91,   514
680 DATA 2A, D3, FE, C2, 88, 16, 8A,  3, 2A, 65, FE, C6, 8A, CE, 32, BD,   640
690 DATA 5A, BA, 3E, 87,  1, 51, 52, 8B,  B, BA,  2, E4,  2, CD, 10, 2E,   514
700 DATA FF, 16, 88,  2, FE, C2, E2, F2, 5A, FE, C6, 55, E2, E7, C2, B4,   AEC
710 DATA  8, CD, 10, A8, C2, 51, AD, 8A, DC, B4,  6, B6,  1,  8, CD, 10,   78B
720 DATA 56, C3, 31, 28, 32, 28, 33, 28, 34, 28, 35, 38, 36, 38, 37, 28,   348
730 DATA 28, 28, 26, 28, 21, 28, B8,  8,  6, BA, 2B, 96,  1, 6B,  B, 61,   456
740 DATA  1, 8B, 16, 62,  1, CD, 10, 8B,  B, 51,  1, 8B, 16, 93,  1, 8A,   4FD
750 DATA 1B, 95,  1, B8, 88,  8, 8B, 16, 61,  1, 81, C2,  2,  1, 52, BE,   5A5
760 DATA 78,  1, B5, 1A,  8, E8, 50,  8, 5A, FE, C6, 52, B6, 1A,  8, 8A,   651
770 DATA 1E, 66,  1, E8, ED,  8, 5A, FE, C6, E6,  A,  8, EE, D2,  2, 51,   746
780 DATA 52, B4,  2, CD, 10, 88, 46,  B, CD, 10, FE, C2, B6,  2,  8, B8,   73I
790 DATA 2B,  8, 5A, FE, C6, 56, E2, E7, 52, E6, 1A,  8, 8A, 1E, 66,  1,   6D2
800 DATA E8, C8,  8, BA, FE, C6, 52, A8, 67,  1, B9, 1A,  8, 80, 27,  1,   733
810 DATA 5A, FE, C6, BE, 86,  7, E6, 10,  8, E8,  4,  8, B8, C6,  8, C3,   79A
820 DATA E4,  2, 8A, 2E, 67,  1, CD, 10, AC, E4,  E, CD, 10, B3, F9, C3,   7AC
830 DATA  8,  8,  8,  8,  8,  8, 86, B, 84,  4, 2A, F5, FE, CE, 88, 26,   4C8
840 DATA 82,  8, 2A, D1, FE, CA, 88, 16, 88,  4, BA, 3B, 67,  1, B4,  2,   651
850 DATA 8B, 1B, B4,  4, CD, 10, E8, DA,  6, E6,  1,  8, CD, 10, FE, C2,   6F8
860 DATA 8B,  B, 88,  4, B8, 5C,  B, B4,  2,  2, 16, 80,  4, CD, 10, E8,   548
870 DATA 86,  6, 8B,  1,  8, CD, 10, B4,  2, 8B, 16, 84,  4,  2, 36, 82,   4F8
880 DATA  4, FE, C6, CD, 10, B8, C8,  6, B6,  1,  8, CD, 10, FE, C3, 8B,   688
890 DATA E, 88,  4, E8, 2D,  8,  8, B4,  2,  2, 16, 88, D9, 1E, 88, D9,   547
8A0 DATA  5, B6,  1,  8, CD, 10, 8B, 16, 84,  4, FE, C6, 52, 8B,  B, 82,   5FA
8B0 DATA  4, 8B, 3D,  E, 5A,  2, 16, 88,  4, FE, C2, 8B,  E, 82,  4, E8,   5C6
8C0 DATA  F,  0, C3, B4,  2, BA, 3B, 67,  1, CD, 10, B8, C4,  6, CD, 10,   5F7
8D0 DATA C2, 8A, 3B, 67,  1, 51, E4,  2, CD, 10, E8, E2,  5, E5,  1,  8,   685
8E0 DATA CD, 10, FE, C6, 59, E2, EE, C3, A8, 9F,  1, B2, C8, F6, B2, BE,   AAC
8F0 DATA F8, 81, C6, 78, 11, E8,  B,  6, 8A, 3E, 56,  1, BE,  E, 61,  1,   688
900 DATA 81, C1,  8,  2, 51, 8B, D1, 81, C3, 13,  6, CD, 10, 5A, 85,  A,   652
910 DATA  8, A8, 9E,  1, FE, C8, 3A,  6, 6F,  1, 79,  C, F6, 26, 9B,  1,   61B
920 DATA 8B,  E, 6C,  1, 2E, C8, E2,  E, 51, 52, E5, 14,  8, E8, 6B, FE,   760
930 DATA 5A, FE, C6, 56, E2, 63, C2, 58, A8, 66,  1, F6, E6, 32, F6,  2,   96C
1000 DATA C2, D1, B8,  1,  6, 6A,  1, 8B, 6B, 47, 8B,  6, 6B,  1, 81, 2B,   66D
1010 DATA 6B,  1,  8, B8, 74,  8, BA, DA,  3, BC, A8,  8, 74, FE, 5B, BA,   736
1020 DATA 67, E2, FC, C3, 8B, 16, 61,  1,  2, 36, 9A,  1, 81, C2,  2,  3,   636
1020 DATA B6, 1A,  8, B8, C1, FF, C2,  8,  8,  B,  7, BF, 78,  F, BB, 16,   63A
1040 DATA 61,  1, 81, C2,  2,  E, B9, 16, C7,  5, B4,  2, BA, 2B, 67,  1,   526
1050 DATA CD, 10, B4,  1, BE,  E, 5B,  1, CD, 10, 22, C9, B4,  8, CD, 16,   623
1060 DATA 3C,  8, 75,  9,  A, C9, 74, F4, B4, 62,  8, EE, EF, 2C,  E, 74,   6DB
1070 DATA 12, 3C, 1B, 74, 3D, 3C, 20, 72, E3, 88, F9, FF, 74, DE, B8, 79,   7F2
1080 DATA  8, EB, D9, 26, 88,  9, 53, 51, 57, BE, 78,  F, BF, 78, 10, B8,   6E6
1090 DATA 71,  8, 73,  E, B8, 9B,  7, E8, A4,  1, 5F, 59, 5B, BB, BD, B8,   782
1100 DATA FA,  8, 73,  5, BB, B6,  7, BB, B8, BB, 78, 10, E8,  2,  1, 83,   77B
1110 DATA C4,  6, B4,  1, B5, 20, CD, 10, B4,  2, 8B, 16, C7,  9, 8A, 2B,   61C
1120 DATA 67,  1, CD, 10, E8, 2B,  A, B6, 19,  8, CD, 10, C2, FE, C5, 4F,   6AF
1130 DATA 88, 65, 18, 77,  6, 51, B4,  E, CD, 10, E8, 28,  A, E9,  1,  8,   5A3
1140 DATA CD, 10, 59, C2, 51, 8B, F7, 82, EE, 19, 89, 19,  8, 8B, 16, C7,   798
1150 DATA  5, E8, BC, FD, 59, C3, BA, FE, C1, 88, F9, 16, 77, E6, B4,  B,   A8C
1160 DATA CD, 10, C3, 57, 47, 22, C9, 22, FF, BA,  8,  A, AC, 88, 7A,  8,   72C
1170 DATA 74, 6A, 2C,  D, 74, 6B, 3C, 2F, 74, 6A, E8, 78,  8, 75, 28, AC,   682
1180 DATA E8, 72,  8, 76, E7, 2C,  D, 74, 5B, BA, FB, C1, 74, 44, EB, BF,   8C8
1190 DATA AC, B8, 56,  8, 74, 44, B8, 5C,  8, 74, 2F, 3C,  D, 74, 2B, 3C,   5CD
1200 DATA 38, 72, 2F, 2C, BA, 72, 19, 24, DF, 3C, 58, 75,  4, B6, 18, EB,   592
1210 DATA DF, 88, FE, 18, 75, 1C, 3C, 41, 72, 18, 3C, 46, 77, 14, 2C,  7,   545
1220 DATA 2C, 28, 8A, D8, 8A, C2, F8, E6,  2, C2,  A, E4, 75,  4, 8A, D8,   86D
1230 DATA BB, B8, 5E, 22, C5, 26, 88,  6, F9, C2, 8A, C2, BA, FE, C1, 74,   5A1
1240 DATA F1, 4B, BB, 85, 5B, 26, 88,  F, F8, C2, 2C, 28, 74,  6, 2C, 2C,   6C8
1250 DATA 74,  2, 2C,  9, C2, 2C, 22, 74,  2, 2C, 27, C2, B4,  2, 8B, 16,   4CF
1260 DATA 8A,  1, CD, 17, F6, C4, 29, 75,  7, F6, C4, F9, 74,  2, F8, C3,   8B2
1270 DATA F9, C3, AC, BA, C8, 22, ED, B3,  E, 8B, 16, 8A,  1, AC, E4,  8,   853
1280 DATA CD, 17, E2, F9, C2, E8, D4, FF, 72,  7, BE, B6,  7, B8, 6B,  8,   988
1290 DATA C3, A0, 56,  1, 6B, 26, 9E,  1,  2,  6, 5A,  1, 2E,  6, 9C,  1,   52C
1300 DATA 72, EE, 8B, C8, 8B, 26, A8,  1, E3,  8, 8A,  4, FE, C8,  2, F8,   848
1310 DATA E2, F8, E8, BD, FF, C2, 45, 72, 63, 28, 45, 6B, 74, 65, 72, 28,   89A
1320 DATA 26, 20, 18, 19, 28, 58, 67, 55, 78, 28, 58, 67, 44, 6B, 45, 72,   45C
1330 DATA 72, 6F, 72, 3A, 28, 49, 6B, 76, 61, 6C, 69, 64, 28, 65, 6E, 74,   5DB
1340 DATA 72, 79, 28, 28, 28, 28, 45, 72, 72, 6F, 72, 2A, 28, 98, 72, 69,   4FA
1350 DATA 6B, 74, 65, 72, 28, 6B, 6F, 74, 28, 72, 65, 61, 64, 79, B8, 12,   659
1360 DATA  8, B8,  7,  E, CD, 10, E4,  1, CD, 16, 74, 6A, BE, 86,  7, E8,   6B2
1370 DATA  1,  8, C3, E4,  2, BA, 2B, 67,  1, CD, 10, 52, BE, 16, 91,  1,   58D
1380 DATA 81, C2,  2,  F, B5, 18,  8, E8, 76, FC, E4,  2, 5A, CD, 10, C2,   726
1390 DATA 55, 72, 61, 67, 65, 2A, 28, 52, 45, 54, 55, 50, 22, 28, 5B, 64,   4F1
1400 DATA 3A, 5D, 5B, 78, 61, 74, 68, 5D, 5B, 66, 65, 6C, 65, 6E, 61, 6D,   633
1410 DATA 69, 5D, 28, 7C, 28, 5B, 2F, 42, 28, 63, 6F, 64, 65, 72, 9D, 28,   4F6
1420 DATA 7C, 28, 5B, 2F, 55, 5D, 24, 41, 6C, 72, 65, 61, 64, 79, 28, 66,   547
1430 DATA 6B, 72, 74, 61, 6C, 6C, 65, 64, 24, 42, 61, 6B, 6E, 6F, 74, 28,   5FR
1440 DATA 75, 6E, 65, 6E, 72, 74, 61, 6C, 6C, 24, 4E, 66, 74, 28, 65, 6E,   626
1450 DATA 73, 74, 61, 6C, 6C, 65, 64, 24, 49, 6B, 76, 61, 6C, 69, 64, 2B,   5F4
1460 DATA 63, 6F, 64, 65, 28, 72, 74, 61, 6C, 6C, 24, 58, 72, 69, 6B, 6F,   6B7
1470 DATA 74, 45, 72, 28, 6B, 6F, 74, 28, 72, 65, 61, 64, 79, 24, 46, 66,   9C4
1480 DATA 6C, 65, 28, 6E, 66, 74, 28, 66, 66, 75, 6E, 64, 24, 46, 66, 6C,   5BD
1490 DATA 65, 28, 74, 6F, 6F, 28, 6C, 61, 72, 67, 65, 24, 49, 6B, 73, 75,   5C5
1500 DATA 66, 66, 66, 63, 66, 65, 6B, 74, 28, 6D, 65, 6D, 6F, 72, 75, 24,   625
1510 DATA 4E, 61, 6E, 65, 28, 66, 65, 6C, 65, 28, 65, 72, 72, 6F, 72, 28,   BA8
1520 DATA 2E, 28, 6C, 65, 6E, 65, 28, 24, 55, 6E, 66, 6B, 72, 74, 61, 6C,   587
1530 DATA 6C, 65, 64, 24,  8, FC, C7,  6,  0,  1,  8,  0, 22, DE, 8C, C8,   585
1540 DATA 43, 8E, C3, 3B, C2, 74, 11, BE,  8,  1, 8B, FE, B6, 18,  8, F2,   71B
1550 DATA A6, 75, ED, C6,  8, E4,  8,  1, BE, 81,  8, AC, 3C, 20, 74, FB,   777
1560 DATA 3C,  D, 75,  2, EB, 6F, 58, 3C, 2F, 74, 11, BA, 27,  0, 88, 2E,   552
1570 DATA B4,  8,  0, 75, 15, 4B, B8, CC,  0, BB, 64, 60, AC, 24, DF, 3C,   742
1580 DATA 55, 74, 18, 2C, 42, 74, 2A, BA,  8,  8, B4,  6, CD, 21, E8,  1,   51C
1590 DATA 4C, CD, 21, BA, BA,  0, 80, 3B, E4,  8,  1, 75, ED, 8B, 75,  8,   6C8
1600 DATA BA, 45,  8, 72, E5, BA, D8,  8, E4,  5, CD, 21, E8,  8, 4C, CD,   770
1610 DATA 21,  E,  7, BF, 78, 11, E8, 2A, FD, BA, 60,  8, 72, CC,  A, C6,   6C8
1620 DATA 74, CB, B8, B7, FD, BA, 7C,  8, 72, C8, BE, 70, 13, B8, C2, FD,   A36
1630 DATA E8,  0,  4C, CD, 21, BA, 27,  8, B8, 2E, E4,  8,  8, 75, AB, B8,   66D
1640 DATA  5, 20, CD, 21, 85, 1E, 8D,  1, 8C,  6, BF,  1, B8,  6, 25, BA,   522
1650 DATA A4,  1, CD, 21, A1, 2C,  8, BE, C8, B4, 46, CD, 21, 8C, C8, 5A,   718
1660 DATA  2,  1, CD, 21, B8,  8, 31, 8B, 16, A2,  1, 81, BA, F1, FF, B1,   72B
1670 DATA  4, D2, BA, CD, 21, 8C, C1, BB,  6, 35, CD, 21, 8C, C8, 3B, C1,   820
1680 DATA 75, 1B, 8E, C1, B4, 46, CD, 21, 72, 12, 1B, B8,  5, 35, 26, C8,   63B
1690 DATA 16, 8D,  1, CD, 21, 1F, 26, F7, 16,  8,  1, F8, C2, 66, C3,  8,   65C
1700 DATA  8,  8,  8,  8,  8, D6, AC, 3C,  F, 74,  4, 3C, 2B, 75, F7,   466
1710 DATA C6, 44, FF,  0, B8,  0, 3D, CD, 21, BA, 8B,  0, 72, 15, A3, EF,   755
1720 DATA  6, 8B, D8, B8,  2, 42, 32, C6, 33, D2, CD, 21,  E, D2, 74,  6,   6AE
1730 DATA BA, 5D,  8, E6, 14, FF, 2D, D8, FF, 77, F5, A3, F1,  5,  4, 4A,   66E
1740 DATA 8B,  8, 1B,  8,  7, CD, 21, BA, AC,  8, 72, B7, B4, 40, 8B, 1B,   43A
1750 DATA F1,  6, 83, C3, 12, B1,  4, D3, E8, CD, 21, BA, AC,  8, 72, D3,   966
1760 DATA A3, F3,  6, B8,  0, 42, 8B, 1E, EF,  6, 22, C6, 22, D2, CD, 21,   726
1770 DATA B4, 26, 8B, 1E, EF,  6, 8E,  E, F1,  5, 22, D2, 2E, 8E, 1E, F1,   6F5
1780 DATA  8, CD, 21, E4, 2E, 2E, 89, 1E, EF,  6, CD, 21, 2B, 8E, 1E, F1,   66B
1790 DATA  9, 80, 7F, FF, 1A, 75,  1, 4B, 81, 7F, FE,  D,  A, 74,  7, C7,   625
1800 DATA  7,  D,  A, B2, C2,  2, C6,  7,  8,  8,  7, 33, F6, BF,  7,  1,   4A1
1810 DATA E8, C7,  8, 88, 3C,  8, 75,  2, BE, 7F, 68, B6, 1A,  8, AC, 2C,   660
1820 DATA D, 75,  3, 46, EE,  6, BA, E2, F5, B8, 99,  8, BF, 78, 11, 56,   77C
1830 DATA A7,  8, 88, 3C,  8, 74, 27, E9, 14,  8, AC, 3C,  E, 74, 14,   538
1840 DATA 3C, 3B, 74,  3, BA, B2, F4, B8, 86,  8, 2B, FF,  6, 6C,  1, B8,   767
1850 DATA 93,  8, EB, DC, B8, 7C,  8, 2B, FF,  6, 6C,  1, 46, EB, D1, 2B,   7BE
1860 DATA 06, 3B, A9,  1, 5B, 2B, 8B,  B, 6C,  1, B3, 16, B8, 6B,  8, AC,   632
1870 DATA 3C,  D, 74, 2B, 3C, 3B, 75, F7, 51, B8, 87, FE, 55, 72, 22, 46,   68D
1880 DATA E2, BA,  E, 1F, 69, 3E, A2,  1, A1, 5C,  1,  8, C8, 74,  A, 46,   632
1890 DATA 66, 26, 5E,  1, FE, C8, A2, 5E,  1, E4, 45, 8E,  8, F2,  5, CD,   821
1900 DATA 21, C3,  B, 1F, B4,  6, BA, C8,  8, CD, 21, A1, 6C,  1, 2B, C1,   668
1910 DATA 4B, E8,  5,  8, EB,  1, 4C, CD, 21, EB,  A,  8, 22, C9, 41, 33,   555
1920 DATA E2, 67, F2, 52,  E, C8, 75, F6, 5A, 88, C2, 2B, E4,  2, CD, 21,   8B4
1930 DATA E2, 66, C2, E2,  4, E8, 2B, F2, AA, C2, 88, 3C, 22, 78,  8, E8,   8F3
1940 DATA  2,  8, EB, F6, C2, AC, 3C,  D, 75, FE, 46, C2,  8,  8,  8,  8,   615
1650 DATA 274818
```

SETUP2.BAS: *By running this BASIC program, you can create SETUP2.COM without using a macro assembler.*

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(continues)

SETUP2 Command

Jeff Prosise May 30, 1989 (Utilities)

Purpose: Sends menu-selected or typed control codes to a printer from within an application or from the DOS prompt.

Format: `SETUP2 [d:][path][filename] | [/C codes] | [/U]`

Remarks: Entered without the /C option, SETUP2 becomes a RAM-resident utility with a pop-up menu of user-configured printer control sequences specified in *filename*. The default hotkey is Ctrl-Right Shift. Esc closes the menu window and returns to any already running application. Entering SETUP2 with the /U option uninstalls the utility if no subsequent TSR program has been loaded.

Any ASCII text editor or word processor can be used to create *filename*, which contains the desired printer commands. This file may be up to 64K in overall size and may contain any number of lines, each of which must be ended by pressing Enter. The first line identifies the printer or company (hit Enter alone to leave it blank) and may be up to 26 characters long. Subsequent lines consist of up to 20 characters of identifying ASCII text, followed by a semicolon, followed by up to 255 bytes containing the printer control sequence. For example, the first four lines of a *filename* for an HP LaserJet might be entered thus:

```
H-P LASERJET
Spreadsheet;    27,''&l1o2e5.647c66F'',27,''&k2S''
Reset Printer;  27,''E''
Form Feed;      12
```

ASCII 27 is the (decimal) escape character; it could alternatively be entered in hexadecimal notation as x1B or 0x1B, following the C-language style. Numeric entries may be separated by commas (as shown) or by spaces or tabs. Literal ASCII text must be enclosed either within double quotes (as shown) or single quotes. White space to the right of the semicolon is ignored, and any line in *filename* beginning with a pound sign (#) is treated as a comment line and will not appear in the SETUP2 window.

In the example just cited, when the SETUP2 menu is popped up with Ctrl-Right Shift, the words "Spreadsheet," "Reset Printer," and "Form Feed" will appear next to lines identified as F1, F2, and F3. The associated printer control codes do not appear in the on-screen menu but are sent to the printer either by pressing the indicated function key or by moving the menu highlight bar to the appropriate line with the Up- and Down-Arrow keys and pressing Enter. The PgDn and PgUp keys bring lines in *filename* beyond the first "page" (ten lines) into the menu window.

SETUP2 Command

Jeff Prosise — May 30, 1989 (Utilities)

Below F10 in the SETUP2 menu is a blank line that may be used to send printer control sequences not contained in *filename*. This line is accessed by pressing the Slash key (/), typing in the actual control codes (using the format conventions previously discussed), and pressing Enter. In this case, the actual printer codes are shown on the screen; the entry line scrolls horizontally to accommodate sequences of more than 100 characters.

Entering SETUP2 with the /C option enables sending printer control *codes* from the DOS command line without making the utility RAM-resident. This is useful both for testing and for batch file operations. The *codes* are again entered with the numeric and quote-mark conventions previously indicated. Note that each line must end with an ASCII 13,10 (carriage return/line feed) sequence.

By default, SETUP2 uses LPT1. Users familiar with DEBUG.COM can change the entry at offset 018A (normally 0) to 1 (for LPT2) or to 2 (for LPT3). Similarly, the default Ctrl-Right Shift hotkey can be changed to another Shift key combination by changing the entry at offset 01B3 (normally 5). A hex value of C in this location would change the hotkey to Ctrl-Alt, for example. A complete table of shift mask values is printed in the original article.

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4. At the USER ID prompt, enter 177000,5000.
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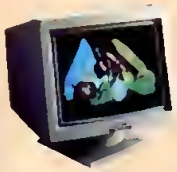

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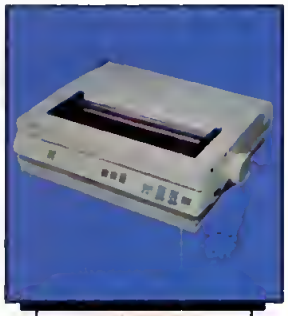

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■ UTILITIES

as the title at the top of the menu window. It may contain up to 26 characters. You'll probably use it for the name of your printer. The line itself is not optional: to leave it blank, insert a blank line in its place in the PMF file.

The lines that follow define printer menus and control codes. Each line contains one string of menu text followed by the codes that are associated with it. Menu text does not have to be enclosed in quotation marks, but it *must* be terminated with a semicolon. The semicolon won't show up in the window; it is used solely to mark where menu text ends and control codes begin. The codes themselves must adhere to the same flexible syntax outlined for entering codes on the command line following a /C qualifier or in the menu window's input bar. Extra white space between control codes is ignored, so you can use spaces, commas, and tabs as desired to format a PMF file for readability.

■ With the menu window popped up, a string of codes can be sent by pressing a function key.

The first three lines in a PMF file for Epson-compatible dot matrix printers might look something like those indicated below:

```
EPSON RX/FX PRINTERS
Elite Mode On;   27,"M"
Elite Mode Off;  27,"P"
```

The menu line text—everything to the *left* of the semicolon—may be up to 20 characters long; any additional characters will be ignored. The control codes and text to the *right* of the semicolon may comprise up to 255 bytes, though only a total of 20 characters will show within the display window. In both of the examples shown above, the code strings are just 2 bytes in length: <ESC> (decimal 27) followed by a control character.

Menu lines are incorporated into SETUP2's menus in the same order in which they occur in the PMF file. For example, if

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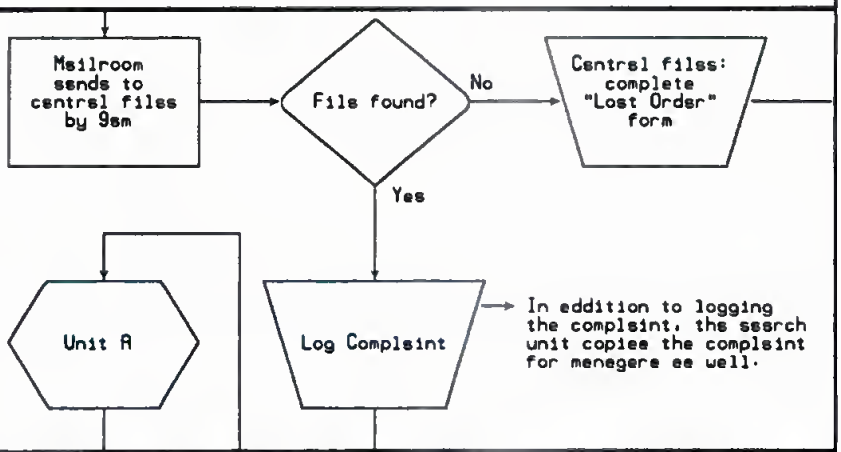

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a file contains 22 separate menu lines, the first 10 will correspond to function keys F1 through F10 on page 1 of the SETUP2 menu window, the next 10 to function keys F1 through F10 on page 2, and page 3 will contain just 2 lines.

With the menu window popped up, a string of codes can be sent either by pressing a function key or by using the Up- and Down-Arrow keys to highlight the desired menu choice and pressing Enter. Use the PgUp and PgDn keys to move between menu pages.

Comment lines can be inserted anywhere into a PMF file. A pound sign (#) in column 1 indicates that a line is to be treated as a comment line. See the PMF file listings in the sidebar "Customizing SETUP2 for Epson Dot Matrix Printers and HP LaserJets" in order to see just a few examples of the ways that comment lines may be used.

If SETUP2 encounters a syntax error while processing a PMF file, it will stop and display the error message "Make file error - line *XXX*," where *XXX* represents the line number where the error occurred. Since only menu lines are included in this count, however, the "line number" will probably differ from that of the physical line in the PMF file. For example, suppose your PMF file contains three comment lines and a title line preceding the first menu line. If SETUP2 reports a make file error in line 5, the error actually lies in the ninth line of the file—the fifth menu line. If an error is reported, SETUP2 will not install itself in memory.

Because of the enormous variety of printers on the market and the lack of any relevant standards, I did not build in a default configuration for SETUP2. You'll find a complete listing of all your printer's capabilities and the control code sequences used to invoke them in the manual that came with it.

MODIFYING THE CODE While the SETUP2 program will allow you to change your printer menus with nothing but an ASCII text editor, there are two additional patch points you might need to change with DEBUG.

If you want to use a hotkey combination other than the default Ctrl-Right Shift, you must replace the value at offset 01B3h

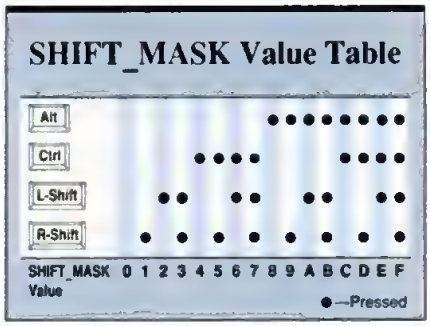


Figure 2: *The shift mask values in the table above correspond to the different hotkey combinations formed with the Alt, Ctrl, Left Shift, and Right Shift keys. Decide which keys you want, then find a column with dots corresponding to those keys but no others. As explained in the text, use DEBUG.COM to enter the value found at the bottom of the column at offset 01B3h in the program.*

(which is normally 5) with a value obtained from the shift mask table shown in Figure 2. Thus, to change from Ctrl–Right Shift to Ctrl-Alt, for example, you need to enter the hex value C. (Remember, DEBUG always thinks in hex.) Assuming DEBUG.COM is in your current DOS path and SETUP2.COM is in your current directory, the entire DEBUG command sequence would be

```
DEBUG SETUP2.COM
E 01B3 0C
W
Q
```

Similarly, if your printer is connected to LPT2 or LPT3 rather than to the default LPT1, you must use the same procedure to change the byte at offset 018Ah (normally 0) to 1 for LPT2 or to 2 for LPT3. Be sure always to make a backup copy of the program before you work on it with DEBUG, so if you make a mistake you'll still have the backup to fall back on.

PROGRAMMING NOTES Like many other pop-up utilities that have appeared in *PC Magazine*, SETUP2 paints a window onto the screen when it senses that the hotkeys have been pressed, and restores the screen upon exit. Unlike many of its predecessors, however, SETUP2 uses BIOS calls to do the reading and writing. This means that if you're running on an older PC, the menu window won't snap into view as quickly as some others, but it also means that SETUP2 will be compatible with a greater number of machines. On a fast 286 or 386 machine, you'll hardly notice the degradation in speed. The one point at which the program accesses video memory directly is when the highlighted menu bar is moved up or down. The reason is that while it's aesthetically acceptable for a window to paint itself on-screen in full view of the eye, a slow-moving light bar looks sloppy.

Programmers may note that in order to make maximum use of memory, SETUP2 stores control codes in a format similar to that of a linked list. Each binary string is preceded by 1 byte that denotes its length. Thus, a code sequence only 1 byte long will require 2 bytes of memory, while a more complex sequence that is 255 bytes in length will consume 256 bytes. SETUP2's internal output routines use the count byte that begins a string of control codes to determine how many characters to transmit to the printer.

SETUP2 also manages memory in a well-behaved manner. Rather than play fast and loose with DOS resources, the program shrinks its initial memory allocation to 64K before processing a PMF file, determines the file's size, and then requests a buffer of that size from DOS. The PMF file is read into the buffer and processed from there. This is an example of how .COM programs *should* behave—in direct contrast to how many of them really do act.

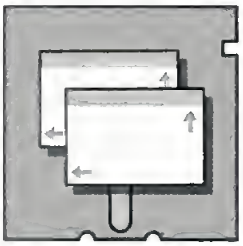
PMF files may be up to 64K in length. Anything greater will cause SETUP2 to report that the file is too large for processing. The number of menu choices and control codes that can be incorporated into SETUP2 is limited only by the number of lines you can fit into one PMF file.

Installed without any menus, SETUP2 will take up slightly less than 4K of memory. The amount of RAM required *with* menus is determined by the number of menu lines and the length of the control code sequences associated with each. As a rule of thumb, count on 21 bytes plus the number of control codes for each line, above and beyond SETUP2's base requirement. PC

Jeff Prosise is a contributing editor of PC Magazine.

■ ENVIRONMENTS ■ CHARLES PETZOLD

IBM'S OS/2 1.1 PROGRAMMING TOOLS



IBM's technical documentation for OS/2 1.1 and the Presentation Manager runs to more than 3,000 pages. Here's a breakdown of what you get, and what to expect from Microsoft.

It's a brave new world in programming. Remember the early days of DOS? Up through Version 2.0, IBM could relegate all the necessary technical information to appendices of its regular DOS user manuals. In the DOS 1.1 manual, the technical information fit in 70 pages with wide margins. IBM's first separately published DOS *Technical Reference* manual (for DOS 2.1) was only about 150 pages.

You didn't need any more. Even today, many DOS programmers get by without any official technical documentation from IBM or Microsoft. DOS and the ROM BIOS are simple enough to be thoroughly documented in programming books. There are even several small reference guides, such as Ray Duncan's *MS-DOS Functions* and *IBM ROM BIOS* (published by Microsoft Press), that provide programmers with most of the information they need to use DOS and the BIOS.

OS/2 and the Presentation Manager are a different story, however. With OS/2 Standard Edition 1.1, you've got an operating system with over 700 documented function calls. Moreover, programming for the Presentation Manager often requires more than just a compiler and technical documentation. Header (or include) files make it much easier for programmers to use the function calls, and various tools with which to design icons, bitmaps, and dialog boxes have become as important as a compiler.

Both IBM and Microsoft are (or will be) selling Programmer's Toolkits and Technical Reference sets for OS/2 1.1. As with OS/2 1.0 itself, IBM released its documentation earlier than Microsoft. IBM began sending free version 1.1 updates to registered purchasers of its original OS/2 1.0 Programmer's Toolkit and OS/2 1.0 Technical Reference packages in January. These updates, which completely replace the earlier editions, began appearing on the shelves of computer stores at the same time.

IBM's OS/2 1.1 Programmer's Toolkit costs $787, and the Technical Reference package is $210—5 percent higher than the original OS/2 1.0 versions. Currently, IBM is supporting Presentation Manager programming for only two languages: C and assembly language. These use the IBM C/2 version 1.1 compiler ($560) and the IBM Macro Assembler/2 ($225), respectively.

MICROSOFT'S PLANS Though its release is still (as of late January) several months away, Microsoft is also expected to produce an OS/2 Programmer's Toolkit. Unlike the IBM version, which separates the toolkit and technical reference, Microsoft intends to consolidate everything into one package.

■ PM programming requires more than just a compiler and technical documentation. Header files make it easier to use function calls.

With OS/2 1.0, the differences between the IBM and Microsoft toolkits were considerable. In particular, IBM's C header files declared the OS/2 functions with uppercase function names; Microsoft's header files used mixed-case function names. And in these header files Microsoft also introduced new data types designed to be consistent with the eventual OS/2 1.1 conventions.

The inconsistencies between toolkits have been eliminated for OS/2 1.1. I expect the C header files in IBM's and Microsoft's packages to be nearly identical. In most cases, the differences will involve only a different copyright notice.

However, I still expect to see some differences between the IBM and Microsoft toolkits. The tutorials will certainly be different, and the function call references may be structured differently. I don't expect to see the same quantity of information on device drivers in Microsoft's toolkit as IBM provides. (Microsoft usually has separate device driver kits.) Naturally, I'll report on the Microsoft toolkit here when I get my hands on it.

WHAT'S IN WHAT It's still not clear to me why IBM chose to separate the OS/2 technical documentation and tools into two packages. I can't imagine a situation where you would need one package but not the other.

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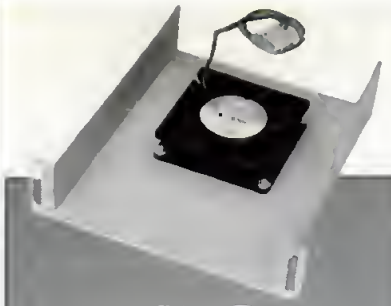

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■ ENVIRONMENTS

The IBM OS/2 1.1 Programmer's Toolkit consists of the following items:

- A 50-page *Programming Overview* manual and a 100-page *Building Programs* manual that cover the basics of programming for OS/2 1.1.
- A 500-page *Programming Guide*, which is a tutorial, with code examples, on programming for OS/2 1.1 and the Presentation Manager. (I'll discuss this below more fully.)
- Two diskettes (in both 5¼-inch and 3½-inch high-density formats) that include C header files, assembler include files, the OS2.LIB import library, tools such as the resource compiler and icon editor, and sample code.

The IBM OS/2 1.1 Technical Reference collection contains only manuals and no diskettes. There are four manuals, however, which are divided into seven volumes:

- A *Programming Reference* manual divided into three volumes that total some 1,400 pages. This documents the OS/2 1.1 function calls, Presentation Manager messages, and the graphics engine interface.
- A 190-page *C/2 Bindings Reference* and a 180-page *Macro Assembler/2 Bindings Reference* that show the OS/2 data structures and functions as they are declared in the C header files and macro assembler include files.
- An *I/O Subsystems and Device Drivers* manual divided into two volumes that contain a total of 870 pages. This manual describes device drivers (including those for PM screen and printer graphics) and IOCTL calls.

LARGE-FORMAT MANUALS The new IBM documentation comes in 8½- by 11-inch softcover manuals with three-hole and two-hole punches. Prior to the release of OS/2 1.1, IBM adapted this format for technical manuals describing OS/2 Extended Edition, and manuals of this size have been common for years for IBM's non-personal computers.

Perhaps surprisingly, the more than 3,000 pages of documentation you get with IBM's two OS/2 1.1 packages occupy only about 5 inches of shelf space. With such a multitude of manuals, however, you may not want to put them on a shelf. For about $45 I ordered a "catalog rack"

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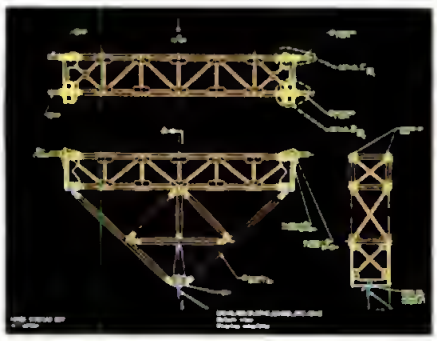
Shaded image of a completed MSL payload on the shuttle



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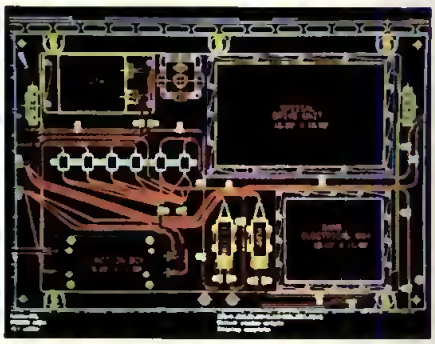
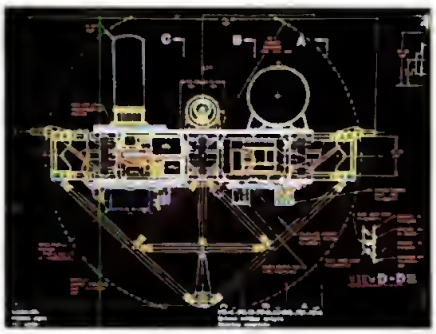
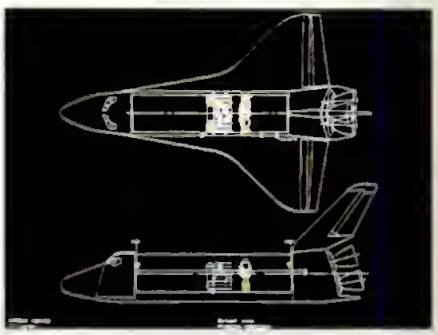


Detail of MSL, shown on MicroStation PC



Materials Science Laboratory (MSL), attached to the support structure, shown on MicroStation PC



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■ ENVIRONMENTS

from my local stationery store. The rack holds all the manuals together at a 30 degree angle to the desk, making a convenient documentation center. If I need the desk space, I can move the thing en masse to a free area of the floor.

A GUIDE TO PROGRAMMING If you're new to OS/2 and Presentation Manager programming, you'll probably spend a lot of time with the *Programming Guide* included in the IBM Programmer's Toolkit. This is the closest thing IBM provides in the way of a tutorial. More than half of it is devoted to the Presentation Manager, but the manual also describes the video, keyboard, and mouse interfaces available to non-PM programs, and covers the file I/O and multitasking components of the OS/2 kernel.

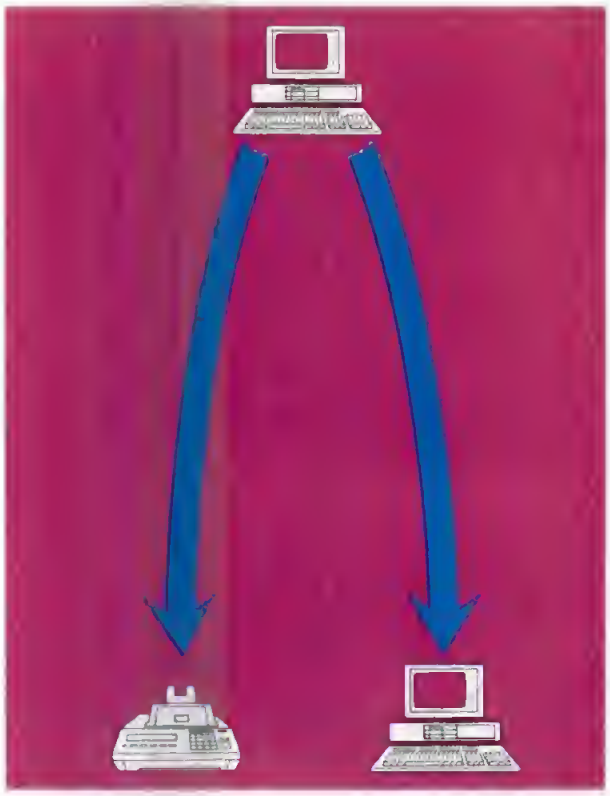
■ If you're new to OS/2 and PM programming, you'll probably spend a lot of time with the *Programming Guide*.

The *Programming Guide* tends to be too overloaded with information to function as a good tutorial, however. Particularly in the early stages, an aspiring Presentation Manager programmer needs a more leisurely introduction, one that concentrates on the essentials rather than attempts to list all the options.

In fact, most Presentation Manager programs do well with a small subset of the available PM functions, and a more useful tutorial would concentrate on this subset. This is, at least, the approach I took in my book, *Programming the OS/2 Presentation Manager*, which will be published this spring by Microsoft Press.

IBM's *Programming Guide* is sprinkled with small errors, but you have to expect that with so new a system. To illustrate the kind of error you'll encounter, the description of the GpiBox function on page 14-5 says, "The box primitive is al-

Easy come. Easy go.



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■ ENVIRONMENTS

ways drawn in a counterclockwise direction." Actually, the direction in which GpiBox draws the box is dependent on how the program specifies the two opposing corners of the box. (And yes, it sometimes *does* make a difference in which direction the GPI draws the box.) The description of GpiBox in the *Programming Reference* manual has the correct description of how this function works.

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FUNCTIONS AND BINDINGS The three-volume *Programming Reference* manual is, naturally, the core of the IBM OS/2 1.1 Technical Reference package. Its first two volumes contain descriptions of all the documented functions, in alphabetical order, with each function beginning on a new page.

Each function is presented with its parameters, possible return values, error codes, and some remarks. When a function involves a data structure, the fields of the structure are also described. I'm particularly happy to see a list of the possible error codes associated with each function; this was missing from IBM's Technical Reference set for OS/2 1.0.

■ The *Programming Reference* manual is the core of IBM's OS/2 Technical Reference package.

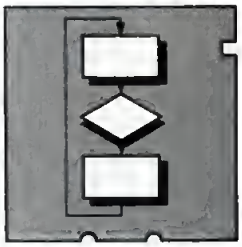
In practice, however, IBM's *Programming Reference* turns out to be a little difficult to use. Although most Presentation Manager programming will be done in C, the function documentation in the manual is language-independent. To find the C syntax and the names of structure fields in the C structures, you must consult the *C/2 Bindings Reference* manual.

This is a sound and traditional way of documenting an API, because it allows the Technical Reference to be used for more than one language. But I think it would be better to show the C syntax along with the language-independent description of each function. It seems to me a small concession to reality.

I don't know yet whether I will eventually use IBM's or Microsoft's reference manuals for my day-to-day OS/2 programming. I will have to wait and see what Microsoft's manuals are like. I suspect that they will be more oriented toward C and easier to use for C programmers. But IBM has done a good job on its manuals, and for the time being, they are more than adequate. PC

■ POWER PROGRAMMING ■ RAY DUNCAN

USING EXTENDED MEMORY, PART 1



Writing programs that access memory above the normal DOS 1MB barrier requires shifting back and forth from protected mode. It's tricky, but here are the ways you can do it.

In today's jargon, *extended memory* is the term used for RAM storage addresses above the 1MB boundary on 80286- and 80386-based PCs. It must not be confused with *conventional memory*, which comprises addresses below 1MB, or with *expanded memory*, which is bank-switched memory that can be mapped as pages into the conventional-memory address space. A sketch of the relationship between conventional memory and extended memory is shown in Figure 1.

If you own a PC AT clone of almost any brand, you probably have at least a small amount of extended memory in your system. These days, such clones typically arrive with 1MB of RAM installed on the motherboard, of which only 512K or 640K actually starts at address 0. The addresses for the remainder begin at 1MB. Moreover, if you have purchased any add-in memory board for an AT-class machine, that board can probably be configured as extended memory, expanded memory, or a combination of both.

The physical, linear address of the magic 1MB boundary is 100000h. Looked at in binary terms, this means that all memory locations above that boundary must have addresses at least 21 bits long. In their protected mode, 80286 and 80386 CPUs are capable of generating these addresses directly, and protected-mode operating systems such as OS/2 and Unix and Xenix can use all the extended memory you can plug into your machine for storing programs and data.

By contrast, DOS and its applications run on the 80286 and 80386 in *real mode*—a sort of 8086/88 emulation mode. In real mode, the 80286 and 80386 CPUs can generate only 20-bit addresses. The obvious implication would seem to be that DOS and its client programs cannot make use of extended memory for storage of programs and data.

Yet our daily experience tells us otherwise. We've all got RAMdisks, disk caches, print spoolers, TSRs, and other utilities of every description that *do* exploit extended memory when it is present. How do these programs reach these "obviously unreachable" memory addresses, and how can you make similar use of extended memory in your programming?

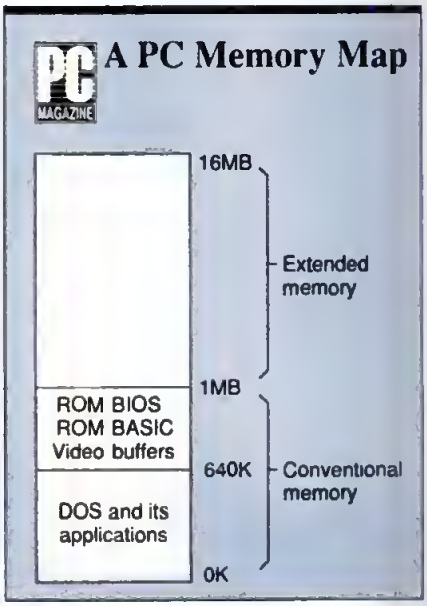


Figure 1: *This diagram shows the relationship between conventional and extended memory. Expanded memory pages (not shown here) are usually mapped into conventional memory between the 640K and 1MB boundaries, although EMS 4.0 also allows pages to be mapped below the 640K boundary.*

ACCESSING EXTENDED MEMORY

The first thing to understand about using extended memory is that the lunch is not free. With but two bizarre exceptions (I'll discuss these in the next issue), a program does have to be running in protected mode to read and write memory locations above the 1MB boundary. And moving safely from real mode to protected mode and back again is not a trivial task.

Simply getting into protected mode from real mode isn't hard. You just set the PE (protect enable) bit in the 80286's MSW (machine status word) and you're there! But unless you've done some additional required housekeeping, your program will immediately crash. Certain data structures and CPU registers that have no meaning in real mode must be initialized. For example, you must set up a global descriptor table (GDT) that controls protected-mode memory mapping, segment types, and access rights, and you must load the address of the table into the CPU's GDT pointer register.

Assuming you manage to enter protected mode and read or write the data of interest, you must then return to real mode so your program can continue its main line of execution. After all, you do want to be able to invoke DOS to read or write files and interact with the user, and I guarantee you

that DOS will be quite confused if you call it in protected mode.

Realizing this, your first inclination would be to haul down your handy Intel *80286 Programmer's Reference* and look up the machine instruction that switches the CPU from protected mode to real mode. Surprise! There isn't one! When the 80286 was designed, Intel's engineers never dreamed that anybody would ever want to make a transition from the clearly superior protected mode back to dull old real mode! Luckily, there is an escape hatch, however undesirable it may sound: if you halt the CPU and restart it, the CPU will restart in real mode.

CAN YOU BELIEVE IT? On 80286-based AT-class machines, the actual technique used by VDISK and such programs for making the switch back to real mode is an almost unbelievable kludge. I can still remember a feeling of incredulity—back in the DOS 2.0 days—when I read through the VDISK and ROM BIOS source listings to find out how they were accomplishing this magic. A certain value is stored in a reserved memory location to serve as a signal to the ROM BIOS, and a special command is sent to the keyboard controller. Then the CPU is halted.

The keyboard controller, in its own good time, recognizes the command and generates a special interrupt that resets the CPU. The CPU then starts execution at FFFF:0000h, as usual, and begins the ROM BIOS POST (power-on self-test). The ROM BIOS checks for the special value that was earlier saved in RAM, realizes—finally—that it is waking up from an intentional halt, and returns control to the previously executing program rather than continuing with the ROM bootstrap. The turnaround time for this whole process can be on the order of several milliseconds. Microsoft's Gordon Letwin has aptly characterized it as "turning off the car to change gears."

Fortunately, things aren't quite so bad on PS/2 or 80386-based machines. PS/2s have special hardware support that allows a faster reset cycle (though the CPU still must be halted for the reset). 80386-based machines, on the other hand, can switch back to real mode by changing a bit in a control register, so they don't need to halt the CPU at all. That's because by the time the 80386 was being designed, it was becoming obvious that DOS and the programs that run under it weren't going to disappear any time soon.

ROM BIOS FUNCTIONS In any event, you don't have to worry too much about these gory details in writing your own application programs, because the ROM BIOS provides two functions that let you access extended memory in a hardware-independent manner. These are interrupt 15h function 87h, which copies a block of data from any location in conventional or extended memory to any other location; and interrupt 15h function 88h, which returns the amount of extended memory installed in the system. The parameters and results of these two functions are outlined

Initializing Extended Memory

Interrupt 15h function 87h—Move Extended Memory Block

Call with:

AH	= 87h
CX	= number of words to move
ES:SI	= segment:offset of global descriptor table

Returns:

If function successful

Carry flag	= clear
AH	= 00h

If function unsuccessful

Carry flag	= set
AH	= status
	01h if RAM parity error
	02h if exception interrupt error
	03h if gate address line 20 failed

The global descriptor table is composed of six 8-byte descriptors used by the CPU in protected mode. The calling program is responsible for initializing the following portions of the table (the remainder, offsets 00h–0Fh and 20h–2Fh, is initialized by the ROM BIOS):

Byte(s)	Contents
00h–0Fh	reserved (should be 0)
10h–11h	segment length in bytes (2•CX-1 or greater)
12h–14h	24-bit linear source address
15h	access rights byte (always 93h)
16h–17h	reserved (should be 0)
18h–19h	segment length in bytes (2•CX-1 or greater)
1Ah–1Ch	24-bit linear destination address
1Dh	access rights byte (always 93h)
1Eh–2Fh	reserved (should be 0)

Figure 2: *ROM BIOS interrupt 15h function 87h, whose parameters and results are shown above, allows data to be moved between any two locations in conventional or extended memory. It is also used to load the required global descriptor table.*

in Figures 2 and 3. (There's an additional function—interrupt 15h function 89h—that allows a program to enter protected mode and stay there, but we'll ignore this one for now.)

The parameter block required by interrupt 15h function 87 is actually a partially filled-in global descriptor table. The ROM BIOS takes care of the remaining necessary initialization of the table before it switches the CPU into protected mode. The most important thing you need to notice about the parameter block is that the addresses you place in it are 24-bit linear byte addresses—numbers from 000000h to FFFFFFh—rather than the more familiar segment:offset pairs. To convert the latter into the former, you shift the segment left 4 bits and then add the offset. The 3 bytes of a linear address are stored in their natural order, with the least-significant byte at the lowest address.

You must use these ROM BIOS routines with caution, if at all, for several reasons. First, of course, data stored in extended memory is volatile; it is lost if the machine is reset or turned off. Second, on 80286-based machines with a PC AT architecture, the switch from real mode to protected mode and back again is a relatively slow process. This can result in lost interrupts for communications programs running at high bps rates and can have other unpleasant consequences. Lastly, programs that use these ROM BIOS functions are incompatible with the DOS Compatibility Box of OS/2.

PRIMITIVE MANAGEMENT You may already have spotted the major weakness of the extended memory functions supported by the ROM BIOS. While they let you access any location in extended memory quite freely, they do not make any attempt to *arbitrate* between two or more programs or drivers that are using extended memory at the same time. For example, if an application program and RAMdisk both attempt to put data in the same area of extended memory, no error will be returned to either program, but the data of one or both may be destroyed.

Regrettably, neither IBM nor Microsoft came up with any standard scheme for the cooperative use of extended memory by DOS programs during the first few years

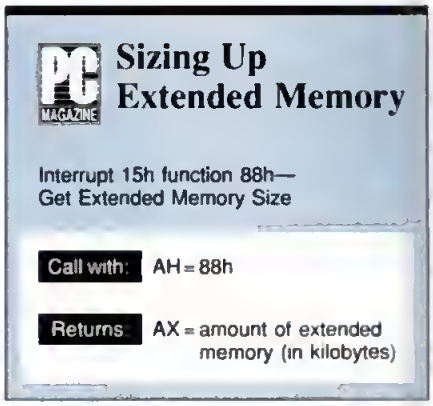


Figure 3: *ROM BIOS interrupt 15h function 88h is used to return the amount of extended memory installed in the system and must be "hooked" by programs that use the "interrupt 15h method" of managing extended memory allocations.*

of the PC AT's existence. Third-party software developers were left to their own devices, and almost all of them eventually settled on one of two methods for extended memory management. I'll call these the "VDISK method" and the "interrupt 15h method."

When a VDISK driver is loaded, it saves information about the amount of extended memory it is using in two places: (1) in a data structure located in conventional memory and found via the interrupt 19h vector and (2) in a data structure located in extended memory at the 1MB boundary. If additional copies of VDISK are loaded (to create additional logical RAMdisks), each looks at both of these areas to determine the amount and location of extended memory still available and updates them to reflect any additional extended memory assigned.

Applications that adopt the VDISK method of extended memory management simply update the interrupt 19h and extended memory indicators in the same manner. At least, they ought to! In actual practice, some applications update only the interrupt 19h area and some update only the extended memory area. As a consequence, if you adopt the VDISK method yourself, you must program very defensively: check both areas, assume that the lesser amount of extended memory is available, and then update both allocation signatures to be consistent and correct for any programs that may be loaded after yours.

The interrupt 15h method of implementing extended memory management is much less complicated. The application calls interrupt 15h function 88h to find out how much extended memory is available and then "hooks" the interrupt 15h vector so as to intercept calls made by other programs. Thus, when the application sees a subsequent call to interrupt 15h function 88h, it returns a reduced value that reflects the amount of extended memory it is using. (All other interrupt 15h calls are simply passed on to the original owner of the interrupt vector.) This technique deceives the other application into believing that the extended memory being used by the first program does not exist.

In sum, the VDISK method allows extended memory to be allocated upward, starting from the 1MB boundary, and the interrupt 15h method allows extended memory to be allocated downward, from the top. Since both management methods are in common use, however, you must take both into account when writing your own programs. Furthermore, neither method provides protection from applications that simply switch into protected mode, find the size of extended memory by reading and writing it directly, and then use it all without regard to other, previously loaded programs.

Moreover, both methods share a fatal weakness: the management is not dynamic but is rather first-in-last-out. If a program terminates and "releases" its extended memory, that memory is not available for use by other programs until all the extended memory that was allocated afterward by other applications is also released.

During 1988—4 years after the introduction of the PC AT—two long-overdue proposals for a more sophisticated, cooperative use of extended memory under DOS were introduced. The first is the eXtended Memory Specification (XMS), which represents a collaborative effort of Microsoft, Intel, AST Research, and Lotus. The second, which applies only to 80386-based systems, is the Virtual Control Program Interface (VCPI), and it is sponsored by Quarterdeck Office Systems and Phar Lap Software. I'll have more to

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■ POWER PROGRAMMING

say about the XMS and VCPI, and in the next installment of this column, I'll be presenting the assembly language and C source code for some extended memory routines you can use in your own programming.

THE VDISK INDICATORS In the discussion above, I was intentionally rather vague about VDISK's data structures. Here are more-specific details of how the VDISK memory management approach works.

VDISK takes over the interrupt 19h vector, which normally contains the address of the ROM BIOS routine that reboots the system, and points it to an interrupt 19h handler within itself. This new handler does nothing more than transfer control to the original handler, so its mere presence does not affect the system's operation. However, a program can fetch the segment portion of the interrupt 19h vector, assume that it points to the beginning of a VDISK driver if one is loaded, and use it to determine whether a VDISK driver is in fact present. If a VDISK driver is loaded, its name and the address of the first free (unallocated) extended memory can be found at fixed offsets from its base.

The exact memory addresses to be inspected may vary from one version of VDISK to another, but you can obtain the necessary information from the VDISK .ASM source file included on the IBM PC-DOS distribution disks. To get a practical, illustrative example, I put the line

```
DEVICE=VDISK.SYS /E
```

in the CONFIG.SYS file of e PC-DOS 3.3 system and rebooted. (The /E switch directs VDISK to use extended memory.) During system initialization I observed the usual message, which indicated that VDISK had created its default-size 64K RAMdisk as logical drive F:. 1 then inspected the interrupt 19h vector and found that it contained the address 1BF3:008Eh. Figure 4 is a hex dump of addresses 1BF3:0000h through 1BF3:003Fh—the first 64 bytes of the VDISK driver.

Bytes 00h through 11h are the VDISK device driver header, which contains information about the driver's entry points, capabilities, and other things of interest to the DOS kernel. In this example, bytes 12h through 2Bh are the initial portion of a volume label that VDISK places in the root directory of its RAMdisk. Dig out your ASCII/hex chart and you'll see that the label contains the string VDISK and the PC-DOS version number. Finally, bytes 2Ch through 2Eh contain the linear address of the first free byte of extended memory: 110000h in this example (1MB + 64K, since VDISK is using the 64K starting at 1MB).

Now let's take a look at the VDISK allocation information stored in extended

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VDISK in Conventional Memory

Device driver header

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
1BF3:0000	00	00	E7	19	00	08	A9	00	D4	00	01	00	00	00	00	00
1BF3:0010	00	00	56	44	49	53	4B	20	20	56	33	2E	33	28	00	00
1BF3:0020	00	00	00	00	00	00	00	00	00	60	86	09	00	00	11	E0
1BF3:0030	18	70	00	08	00	21	1C	45	00	00	00	00	10	10	00	08

Partial volume label

Linear byte address of free extended memory

Figure 4: *Above is a hex dump of the first 64 bytes of the memory occupied by the PC-DOS 3.3 VDISK driver. The base address of the driver was found by inspecting the interrupt 19h vector, which (in this instance) contained the address 1BF3:008Eh. In this particular version of VDISK, the 24-bit linear address of the first byte of free extended memory (110000h) is found in offsets 002Ch through 002Eh.*

VDISK in Extended Memory

Indicates not bootable

OEM identity field

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
100000	00	00	00	56	44	49	53	4B	33	2E	33	80	00	01	01	00
100010	01	40	00	00	02	FE	06	00	08	00	01	00	00	00	40	04
100020	51	8A	C3	AA	B8	FF	FF	AB	8B	CA	33	C0	F3	AA	59	E2
100030	EF	B9	1A	00	F3	A4	B8	20	00	F7	26	51	00	2D	1A	00

BPB

Start of free extended memory (in kilobytes)

Figure 5: *This hex dump shows the first 64 bytes of extended memory after the PC-DOS 3.3 VDISK driver is loaded. This memory section is set up to simulate the "boot block" of a normal DOS disk device, and so contains an "OEM Identity Field" in offsets 03h–0Ah and a valid BIOS Parameter Block (BPB) in offsets 0Bh–1Dh. The bytes at offsets 1Eh and 1Fh hold the address of the first free extended memory: 0440h (1,088K) in this example.*

memory. Figure 5 contains a hex dump of addresses 100000h through 10003Fh, which are the 64 bytes beginning at the 1MB boundary. This memory is part of the first logical sector of VDISK's RAMdisk storage, so VDISK makes it look like the boot sector of a normal DOS block device. Offsets 00h–02h contain zero, showing that the disk is not bootable; bytes 03h–0Ah are the "OEM identity field" and contain the string "VDISK3.3"; and bytes 0Bh–1Dh are the "BIOS Parameter Block" (BPB), from which DOS can calculate the locations of the FAT, the root directory, and so on.

The 2 bytes at offset 01Eh and 1Fh are what we want to see. If you look at the source code for VDISK, you'll find that these 2 bytes are treated as a *word* field and that they contain the address (in kilobytes) of the first free extended memory. In this particular case, the word contains 0440h (1,088K), which is again 1MB (1,024K) + 64K.

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EDITOR'S CHOICE

PC MAGAZINE

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PC MAGAZINE EDITOR'S CHOICE

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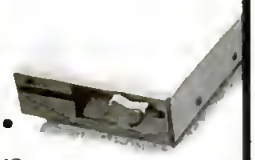

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■ POWER PROGRAMMING

The responsibilities of a program you might write that uses the VDISK method for extended memory management are now a bit clearer. The program must first find the total amount of extended memory available by calling interrupt 15h function 88h. This will protect it against the programs that use the interrupt 15h management method. It must then inspect the interrupt 19h vector to find out whether the vector points to the base of an already-loaded VDISK driver.

If a VDISK driver is already resident, the new program must inspect both the fields within the driver itself and the boot block at the 1MB boundary, so as to determine the starting address of available extended memory. If these are inconsistent, your program should use the higher of the two. It must decide how much memory to reserve for itself and then update the two fields just mentioned to reflect that amount of "allocated" extended memory.

If no VDISK driver is present in the system, your program can take the easy way out: hook the interrupt 15h vector and use the interrupt 15h method of memory management. Alternatively, it can pretend that it is a VDISK by pointing the interrupt 19h vector to something that appears to be a VDISK driver header and by creating a phony boot block at 1MB. In either case, the program must also install its own Control-C (interrupt 23h) and critical-error (interrupt 24h) handlers so that it cannot be terminated unexpectedly.

Regardless of the allocation method used, your program must be careful to exit gracefully so that it removes all evidence of its presence and so that any extended memory it used is not orphaned. If the interrupt 15h vector was captured, that vector must be restored to point to the previous owner. If the VDISK indicators were modified, they must be returned to their proper state to "release" the memory. This can be quite tricky if another driver or TSR has allocated some extended memory to itself after your own application program.

THE IN-BOX Please send your questions, suggestions, and comments to me at any of the following e-mail addresses:
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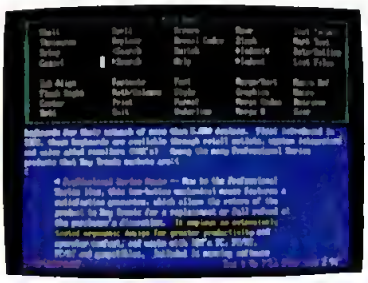

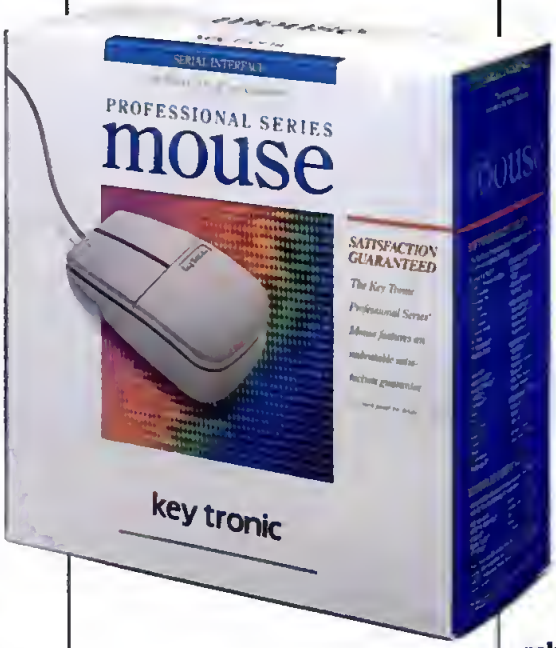

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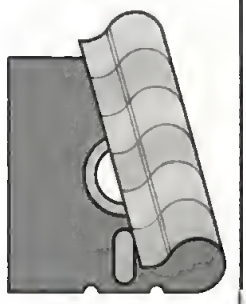


Protecting your 1-2-3 worksheets from prying eyes; determining the median of a range of values; a 1-2-3 macro for replacing the value in a cell with a value calculated from it.

Replacing the value in a cell with a value calculated from it

In many of my *1-2-3* macros I need to replace the value in a cell with the result of a formula or function that uses that value. To do this, I move the cell pointer to that cell and invoke a macro routine like the one shown below:

```
{Edit}operation{Calc}~
```

where *operation* specifies the operation I want to perform on that value. The {Calc} instruction recalculates the formula while it is still on the Edit line, replacing that formula with its result. The tilde (~) command hits Enter, locking the new value into the current cell and overwriting the previous value. Thus, the routine

```
{Edit}*2{Calc}~
```

doubles the value in the current cell.

An alternative routine to accomplish the same doubling in the Point mode is

```
{Edit}+{Down}{Up}X{BS}{Calc}~
```

The {Down} and {Up} commands put *1-2-3* into the Point mode, and point to the current cell. If the cell pointer was on A1, for example, and that cell contained the value 123, the formula 123+A1 would be displayed on the Edit line at this point.

Unfortunately, *1-2-3* does not allow you to calculate a formula on the Edit line while it is in the Point mode. To return to the Edit mode, therefore, the macro types a dummy character (in this case, X) and presses the Backspace key to erase it. The macro can then recalculate the formula and place the result—double the original value—into the current cell.—*Neil G. Gardner; Huntington Woods, Michigan*

Mr. Gardner's method is the best way we know to replace the value in a cell from within a *1-2-3*, Release 1A, macro. If you use a later release of *1-2-3*, however, a {Let} statement is the method of choice. For example, to double the value in cell B5 of a *1-2-3*, Release 2 or 2.01, worksheet, you would use either the statement

```
{Let B5,B5*2}
```

or

```
{Let B5,B5+B5}
```

Unlike Mr. Gardner's method, this does not require moving the cell pointer to the cell whose value you want to alter.

If you want to modify the value in the current cell, use a calculated {Let} statement. For example, the routine shown in Figure 1 doubles the value in the current cell of a *1-2-3*, Release 2 or 2.01, worksheet. The command in cell B1 instructs *1-2-3* to recalculate the string formula

```
B2:  +"{Let "&@CELLPOINTER("address")
          &",@CELLPOINTER(""contents"")*2}"
```

The result of this formula will be a valid {Let} statement that commands *1-2-3* to enter the result of the function

```
@CELLPOINTER("contents")*2
```

into the current cell. For example, the formula in cell B2 would return the string

```
{Let $B$5,@CELLPOINTER("contents")*2}
```

if the cell pointer was on cell B5 when you invoked this macro. This statement would double the value in cell B5.

Here's a way to determine the median of a range of values

While working in *Lotus 1-2-3*, I often need to determine the median of a list of values. For an odd number of entries, the median is simply the middle value when the range has been sorted in ascending or descending order. For an even number of values, the median must be calculated by adding the two middle values and dividing by 2.

Unfortunately, *1-2-3* does not have an @MEDIAN function that will do the work for you. Consequently, after sorting the values in the range into ascending or descending order in a single column, I apply

```
     A        B          C          D          E          F
1    \d       {Recalc NEXT}
2    NEXT     {Let $B$2,@CELLPOINTER("contents")*2}
3
```

Figure 1: *This 1-2-3, Release 2 or 2.01, macro routine uses a calculated {Let} statement to double the value in the current cell of your worksheet.*

■ SPREADSHEET CLINIC

a formula in the form

```
@IF(@MOD(@ROWS(RANGE),2)=1,
@INDEX(RANGE,0,@INT(@ROWS(RANGE)/2)),
(@INDXX(RANGE,0,(@ROWS(RANGE)/2)-1)
+@INDEX(RANGE,0,@ROWS(RANGE)/2))/2)
```

In applying the formula, you simply replace the *range* with the actual address (B1..B10, for example) of the desired range.

Here's how the formula works. The conditional test of the @IF function, @MOD(@ROWS(range),2)=1, determines whether the list contains an even or odd number of values. If there is an odd number of values in the list, *1-2-3* uses the function

```
@INDEX(range,0,@INT(@ROWS(range)/2))
```

to calculate the median. This function returns the middle value from the range. The value 0 tells *1-2-3* to look in the first (and only) column in the range; the argument @INT(@ROWS(range)/2) identifies the middle row, whose value will be returned by the @INDEX function.

If the range contains an even number of values, *1-2-3* will use the formula

```
(@INDEX(range,0,(@ROWS(range)/2)-1)
+@INDEX(range,0,@ROWS(range)/2))/2)
```

to calculate the median. This formula adds the two middle values in the list and divides by 2. The result is the median.—*Jordan Engel; Washington, D.C.*

Mr. Engel's formula certainly works well, but it is a bit difficult to enter the addresses repeatedly. Consequently, we suggest that, in addition to sorting the range of values, you assign the name RANGE to that range. Then, you can use the macro shown in Figure 2 to calculate the median. This macro types the formula

```
@IF(@MOD(@ROWS(rangs),2)=1,
@INDEX(range,0,@INT(@ROWS(range)/2)),
(@INDXX(range,0,(@ROWS(range)/2)-1)
+@INDEX(range,0,@ROWS(range)/2))/2)
```

onto the Edit line, recalculates it, and then enters the result—the median—into the current cell.

If you wish to automate the entire process, you can use the macro shown in Figure 3. This macro inserts a new column to the left of the one that contains the values you want to sort, copies those values (or, if any of the cells in the range contain formulas or functions, the results of those formulas or functions) into the new column. Then, *1-2-3* sorts the copied values and uses the @IF formula shown above to calculate the median. Then, *1-2-3* returns the worksheet to its original condition.

```
     A       B          C          D          E          F
1    \m      @IF(@MOD(@ROWS(RANGE),2)=1,
2            @INDEX(RANGE,0,@INT(@ROWS(RANGE)/2)),
3            (@INDEX(RANGE,0,(@ROWS(RANGE)/2)-1)
4            +@INDEX(RANGE,0,@ROWS(RANGE)/2))/2)
5            {Calc}~
6
```

Figure 2: *This macro calculates the median of a list of sorted values.*

```
     A       B       C       D       E       F       G       S       I
1    \m      {GetLabel "Press (Enter], then highlight the column of values...",NULL}
2            /rncVALUES~{Esc}{?}~
3            {Goto}VALUES~
4            /wic~
5            /rvVALUES~~
6            /rncRANGE~{Down @ROWS(VALUES)-1}~
7            /rndVALUES~
8            /dsrdRANGX~p~e~g
9            {Let MEDIAN,@IF(@MOD(@ROWS(RANGE),2)=1,@INDEX(RANGE,0,
             @INT(@ROWS(RANGE)/2)),(@INDEX(RANGE,0,(@ROWS(RANGE)/2)-1]
             +@INDEX(RANGE,0,@ROWS(RANGE)/2)1/2]}
10           /rndRANGE~
11           /wdc~
12
13   NULL
14   MEDIAN
15
```

Figure 3: *The macro above sorts the list of values you specify and calculates their median.*

Password protection to blank your screen from prying eyes

While working with a sensitive *1-2-3* worksheet, you may not want to leave it on-screen when you step away from your desk. You can always save it, erase it, and then retrieve it when you return, but if the worksheet is large, this can waste time that you may not be able to spare.

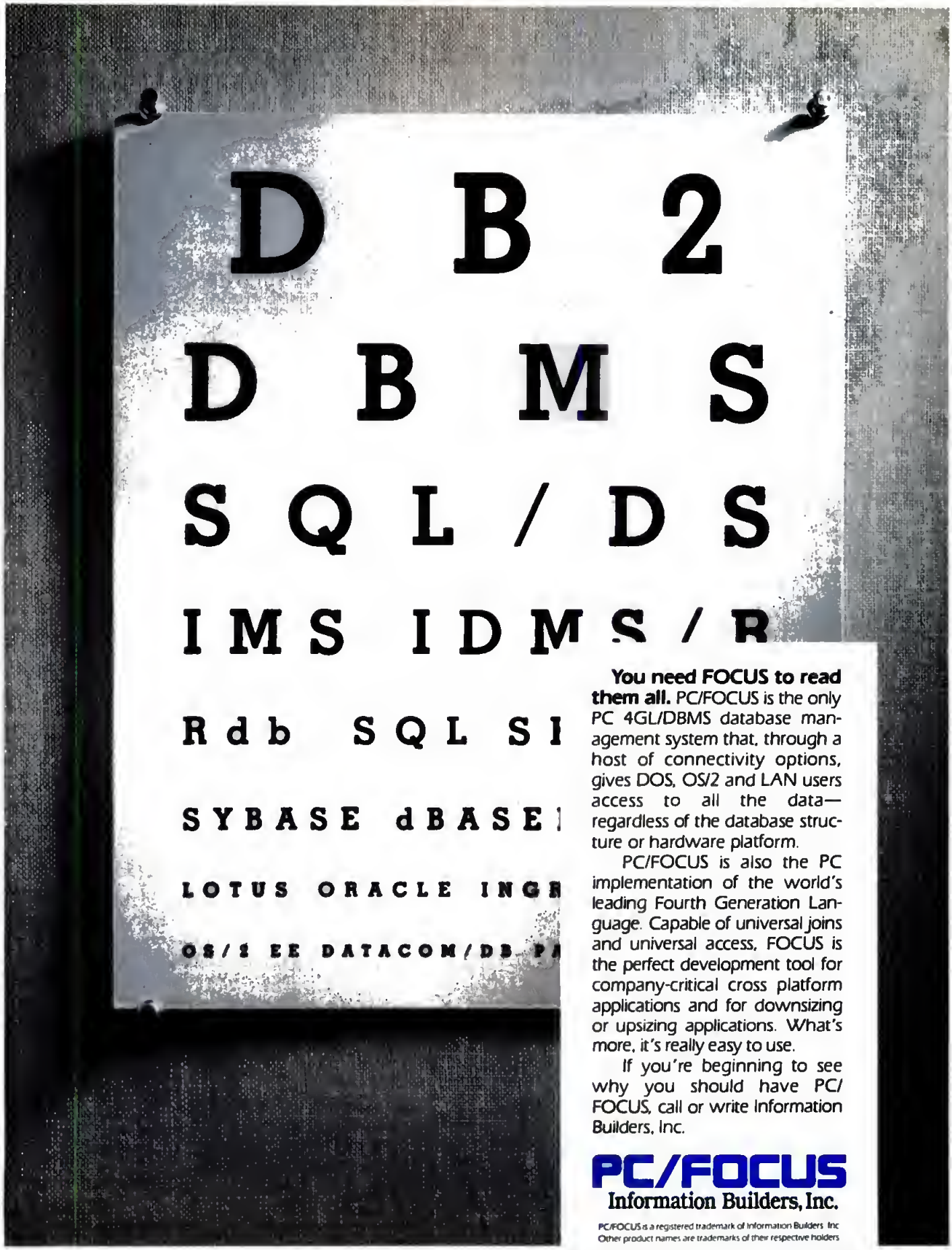
Fortunately, there is a way to prevent people from viewing and working with a worksheet—without requiring you to remove it from RAM. Simply by invoking the macro shown in Figure 4, you can blank the screen of your computer.

The macro uses file I/O commands to write information to the screen of your computer rather than to a file. A special ANSI escape sequence within a {Write} command blanks the screen. Before doing so, *1-2-3* asks you to supply and confirm a password. Once *1-2-3* blanks the screen, it won't redisplay the worksheet until you retype the correct password.—*Frank Johnson; Minneapolis, Minnesota*

The macro Mr. Johnson has created makes use of a technique we discussed in the December 27, 1988, issue's Spreadsheet Clinic. We explained there that if you specify the DOS device name CON as the argument of an {Open} command, *1-2-3* will send the information specified by subsequent {Write} commands to the screen of your computer rather than to a file. In addition to sending text to the screen, you can send escape sequences that move the cursor, invoke various attributes, and erase characters. The four-character sequence, ESC[2J, blanks the entire screen and is the key to this macro.

In order to understand the escape sequences sent to it, your computer must read ANSI.SYS when it boots. Thus, a copy of ANSI.SYS must be located in the root directory of the disk with which you boot your machine. That directory also must contain CONFIG.SYS, which must contain the statement device=ansi.sys.

Normally, *1-2-3* translates character 27 (the escape character) into character 32 (the space character) when a {Write} command instructs it to export that character. Since the ESC character is an integral part



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■ SPREADSHEET CLINIC

```
        A         B         C         D         E         F         G
1   \b        {GetLabel "Specify Password: ",PASSWORD}
2             {GetLabel "Confirm Password: ",CONFIRM}
3             {If #NOT#@EXACT(CONFIRM,PASSWORD)}{Branch \b}
4             {BreakOff}
5             {Open CON,W}
6             {Write @CHAR(027)&"[2J"}
7   INPUT     {GetLabel "Password? ",RESPONSE}
8             {If @EXACT(RESPONSE,PASSWORD)}~{Quit}
9             {Branch INPUT}
10
11  PASSWORD
12  CONFIRM
13  RESPONSE
14
```

Figure 4: *This* 1-2-3 *macro blanks your screen until you retype a password.*

of the sequence needed to blank the screen, you must instruct *1-2-3* not to translate that character. To do this, you must alter the character-translation table within the .SET file you use to load *1-2-3*. To learn to alter this file, see the December 27, 1988, issue's Spreadsheet Clinic.

The first statement in Mr. Johnson's screen-blanking macro tells *1-2-3* to display the prompt Specify Password: at the top of the screen and wait for your reply. Type the password you'll want to use later to unblank the screen. When you press Enter, *1-2-3* stores this in the cell named PASSWORD (B11). The statement in cell B2 then asks you to retype the password. Pressing Enter locks your response into the cell named CONFIRM (B12).

The statement at the beginning of cell B3 compares your responses with the two {GetLabel} commands. If you did not type exactly the same response to the second {GetLabel} statement, this statement will be true, and *1-2-3* will execute the {Branch} command at the end of cell B3. This routes the execution of the macro back to the cell named \b (B1), which in turn allows you to respecify the password.

If you retype the correct password, *1-2-3* executes the {BreakOff} command in cell B4. This disables the {Break} key, preventing anyone from canceling the execution of the macro by pressing Ctrl-Break.

The '{Open CON,W} statement then opens the screen for access by *1-2-3*'s {Write} command. The next statement sends out the four characters [ESc], [, 2, and J. When interpreted by ANSI.SYS, this sequence blanks the screen.

As soon as *1-2-3* blanks the screen, it executes the statement in cell B7, which writes the Password? prompt at the upper-left corner of the screen and waits for your reply. It also redraws the first and last lines, leaving the rest of the screen blank.

When you get back to your desk, you simply type in your password and hit Enter, which locks your response into the cell named RESPONSE. The {If} statement at the beginning of cell B8 then executes, and if your response exactly matches the label stored in PASSWORD (including capitalization), *1-2-3* continues with the remainder of the commands in cell B8. The first of these commands, ~, redraws the screen, revealing the same image that was on the screen before the macro blanked the screen. The next command, {Quit}, cancels the execution of the macro.

If your response does not match the password, *1-2-3* will skip those commands, executing the statement in cell B9 instead. This statement routes the execution of the macro back to cell B7, which asks you for the password again. *1-2-3* will continue in this loop until you supply the correct password or reboot your computer.

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■ NEIL J. RUBENKING

USER-TO-USER

Patch COMMAND.COM to delete files with confidence; a simple batch file that compares the contents of two directories; a method for recovering files with ease.

Comparing the contents of two directories with COMP

When comparing two groups of files in different directories, COMP checks to see only that all of the files in the first directory are present in the second directory. Files that exist in the second directory but not in the first are not noted in any way.

REALCOMP.BAT, shown in Figure 1, performs the COMP twice, reversing the order of the directories the second time, and stores the results of both comparisons in a temporary file. The file is then typed through a filter that removes all of the successful comparisons. The file ANSWER.NO, which is directed into the COMP commands, consists of an n, a carriage return, and a Ctrl-Z End-of-File marker. Its full pathname must be included.

I would like to know if you have a method for suppressing the "Compare more files (Y/N)?" message that the batch file displays. I couldn't figure out a way to pipe the output of the comparisons to the temporary file and still use the technique of piping the output to NUL in order to suppress the message.—*Barton A. Gravatt; Homer, New York*

This file isn't using the ability of COMP to compare files—it's just using it to check for their presence. The resulting list contains the full path of any file that appears in only one of the two directories. The comparison of files that *do* appear in both directories gets filtered out.

```
ECHO OFF
IF %1.==. GOTO ERROR
IF %2.==. GOTO ERROR
COMP %1 %2 > STOPGAP.FIL < ANSWER.NO
COMP %2 %1 >> STOPGAP.FIL < ANSWER.NO
CLS
TYPE STOPGAP.FIL | FIND "File not found"
ECHO.
DEL STOPGAP.FIL
GOTO END
:ERROR
ECHO.
ECHO You must include two pathnames.  Press any key to continue.
ECHO.
PAUSE > NUL
:END
```

Figure 1: *REALCOMP.BAT produces a list of files that appear in one of the two directories.*

The ANSWER.NO file isn't really necessary. You can get the same effect by piping an N to the COMP command, for example,

```
ECHO N | COMP %1 %2 > STOPGAP.FIL
```

But avoiding the "Compare more files" question is more difficult. COMP writes that message to the standard error device, not to standard output. As a result, even CTTY NUL won't hide it. There are utilities that will redirect standard error, but I prefer to just put a CLS after the unwanted screen output. I've added that CLS in REALCOMP.BAT.

A simple deletion technique that makes it easy to recover your files

While lacking a file unerase utility, I needed a way to make accidentally deleted files recoverable. DOS provides no easy way to recover the files it deletes. So I created two batch files: DE.BAT "deletes" files and UNDE.BAT recovers the last file you deleted.

DE.BAT is shown in Figure 2 and uses the same syntax as DOS's DEL command, including wildcards. However, it does not actually delete files. Instead it moves them to a temporary subdirectory named TRASH on RAMdisk drive D:. This way, if you change your mind, you can recover these files from this subdirectory as long as your computer has not been shut off or rebooted. You must create this directory before using this file.

The error message "Deletion halted . . ." in line 18 warns you that there is no TRASH subdirectory, the RAMdisk is out of room, or there is no RAMdisk installed. It will give you a chance to exit before the file is permanently deleted.

UNDE.BAT in Figure 3 is a quick way to retrieve the last deleted file to your cur-

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CIRCLE 170 ON READER SERVICE CARD

■ USER-TO-USER

```
@ECHO OFF
IF "%1"=="" GOTO Err
IF NOT EXIST %1 GOTO err1
COPY %1 D:\TRASH\%1 > NUL
IF NOT EXIST D:\TRASH\%1 GOTO Err2
REM doesn't work with pathname in %%1
SET LDF=%1
DEL %1
GOTO End
:Err
ECHO I need a file specification please ...
GOTO End
:Err1
ECHO %1 not found
GOTO End
:Err2
ECHO ^G
ECHO Deletion halted... please check D:\TRASH
ECHO Press Ctrl-C to exit or any key to permanently delete %1.
PAUSE > NUL
DEL %1
:End
```

Figure 2: *Instead of deleting files, DE.BAT moves them to the TRASH subdirectory. You can recover a file as long as your machine hasn't been turned off or rebooted.*

rent directory. The syntax is just

```
UNDE
```

that is, the batch file's name. Both of these files can be easily modified and expanded to handle various deleting jobs.—*Jim Chong; Niagara Falls, Ontario, Canada*

This idea lends itself to variations. If you have enough space on your hard disk, put the TRASH directory right on your disk. This will give you the ability to "unerase" a file even if you've turned off your computer since the time you "erased" it. Of course, you'll have to empty the TRASH from time to time.

To save space, you might use a file compression program such as *ARC* from Software Enhancement Associates or *PKARC* from PKWare. Instead of copying the file to the TRASH directory, add it to the TRASH archive.

Unlike the DEL command, DE.BAT doesn't work with pathnames. If you pass it a filespec that includes a pathname (C:\DATA\JUNK, for example), it will report that the file did not get copied to the TRASH directory. That's because the fifth line will test for the existence of D:\TRASH\C:\DATA\JUNK—a mess. Use DE.BAT only on files in the current directory.

The author states that DE.BAT works with wildcards. It does, but there's a danger. Suppose you use DE on the filespec *.BAK. Suppose further that the TRASH directory has room for only one more file. The first *.BAK file gets copied, but none of the others do. Now the fifth line tests for a successful copy by checking the existence of D:\TRASH*.BAK. One matching file is enough to prove existence, so DE merrily deletes all of the *.BAK files, leaving only one of them unerasable.

If you want to use DE safely with wildcards, there is a way. Rename the existing file to DE1.BAT, and create a new DE.BAT with these lines:

```
@ECHO OFF
FOR %%v IN (%1) DO CALL DE1.BAT %%v
```

Now DE1.BAT acts on each matching file individually, so there's no possibility of problems due to wildcards. If your DOS

```
@ECHO OFF
IF NOT EXIST D:\TRASH\%LDF% GOTO Err
COPY D:\TRASH\%LDF% > NUL
ECHO Last Deleted File = %LDF%
Echo Recovered in
CD
GOTO End
:err
ECHO File D:\TRASH\%LDF% not found
:End
set LDF=
```

Figure 3: *UNDE.BAT retrieves the last file you put in the TRASH.*

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■ USER-TO-USER

version is earlier than 3.3, you'll have to use COMMAND /C in place of the CALL statement. This creates a problem for UNDE.BAT—the LDF environment variable gets set within a secondary command processor and disappears as soon as DEI .BAT ends. If you want to use the "safe" DE.BAT with any DOS version earlier than 3.3, all you have to do is edit UNDE .BAT and replace the references to %LDF% with %1. Your new UNDE.BAT will require a command line parameter to tell it *which* file to undelete.

Productivity Tip

All of the Extended ASCII characters (those with ASCII values greater than 128) are available for your use when naming files. Because you have to enter them by pressing Alt and typing on the numeric keypad, you don't want to use them often. However, for special files consider using names that *are* difficult to enter, like αβ.DAT.

Add this verify feature to make sure you don't delete the wrong files

Being a veteran CP/M user, I'm used to having my computer display all files pending to be deleted, then prompting if it should continue. Below is a sample of how it worked:

```
C0>ERA *.BAK

LETTER  BAK | BACKUP  BAK | STARTREK  BAK
MEMO    BAK | MODEMIO  BAK | SISCORE   BAK

Ok?
```

As you can see, the files pending to be deleted were displayed, and then the system would prompt if it was OK for you to continue. An answer of Y would cause the files to be deleted, and an answer of N would abort the operation.

This verification saved me from accidentally deleting files many times. Now, however, I use an MS-DOS computer. Too often I have deleted all my .BAT files from a directory when I wished to delete the .BAK files. If a directory of files pending to be deleted had been displayed, I would have discovered my typo. So I devised a way to visually verify my files *before* I delete them.

First, create the small batch file DEL .BAT, shown in Figure 4, and place it in a directory where it can be accessed from any drive or directory within your system (via the PATH command).

Next, make sure you have DEBUG .COM available. Then go to your root directory and make a copy of your COMMAND.COM program, giving it another name such as COMMAND.BAK. This will give you a backup of COMMAND .COM in case the original gets corrupted

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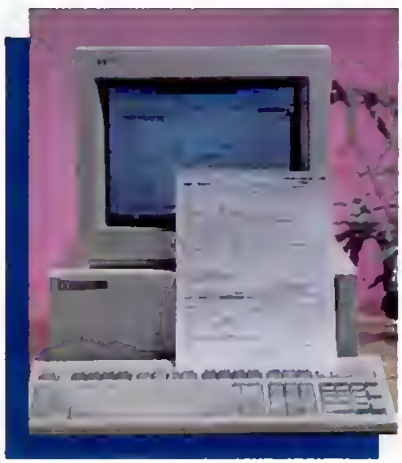

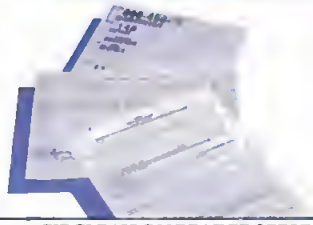

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CIRCLE 742 ON READER SERVICE CARD

■ USER-TO-USER

while making these changes. Now enter

```
DEBUG COMMAND.COM
```

DEBUG will load COMMAND.COM into memory, where you can modify it. MS-DOS must be forced to use the DEL batch file instead of the internal DEL command. You can do this by changing the uppercase D in DEL to a lowercase d so the command interpreter won't be able to find it. Instruct DEBUG to find the DEL command by entering

```
S CS:FFFF "DEL"
```

at the - (hyphen) prompt. DEBUG will return with an address where it found the search text of DEL. Now enter the following command:

```
E ####:#### "d"
```

where ####:#### is the address that the previous search command returned. Verify that all has gone well by using the Dump command and by entering

```
D ####:####
```

where ####:#### is again the address given to us by the search command. The Dump command causes DEBUG to display a section of memory starting at the address given. Viewing the right-hand portion of the screen, you should see the DEL command with a lowercase d, and an up-

```
@ECHO OFF
IF "%1"=="" GOTO NoParam
ECHO The following files will be deleted:
DIR/W %1
ECHO .
ECHO Press Ctrl-C to abort, or
PAUSE
ERASE %1
GOTO End
:NoParam
REM This is the message the internal DEL gives!
ECHO Invalid number of parameters
:End
```

Figure 4: *This batch file must be accessible from any drive or directory within your system. In order to make DEL.BAT replace the internal DEL command, you must make DEL unrecognizable by patching COMMAND.COM itself.*

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■ USER-TO-USER

percase EL. If you do, enter

```
W
```

to write the changes to disk. If you don't see DEL displayed thus, skip this command and exit DEBUG by entering

```
Q
```

After you've written the changes to disk, reboot your machine. The new command should be operational. When you enter

```
DEL filespec
```

the DEL.BAT file will be invoked. It first displays a directory of the filespec and pauses until the operator presses any key to continue, or Ctrl-C to abort.

Note that COMMAND.COM's ERASE command can still be used to delete without verification, if for some reason this is desired (possibly by other batch files, just like our DEL.BAT file!). —*Allen Howell; Arcanum, Ohio*

Always make a backup before meddling with COMMAND.COM, and be prepared to reboot from a floppy disk if you make a mistake. However, naming your backup copy COMMAND.BAK seems unsafe to me, since I frequently delete every *.BAK file. I would suggest something different, like COMMAND.SAV, and make it Read-Only.

■ You can "patch out" other DOS commands, to replace them with batch files or to disable them.

You can "patch out" other DOS commands, either to replace them with same-named batch files or simply to disable them. However, a patched COMMAND.COM makes your system nonstandard. If anyone else has to use your system, he may be unpleasantly surprised by the difference. To use the batch file described here without patching COMMAND.COM, just give it a name that's not a built-in DOS command, like DELL.BAT.

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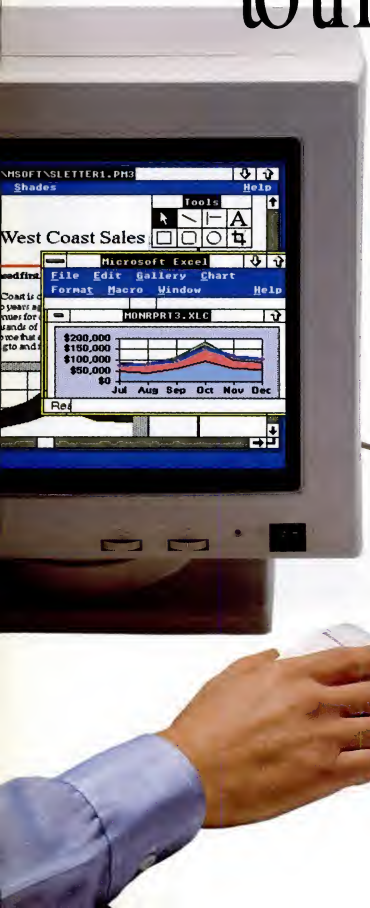

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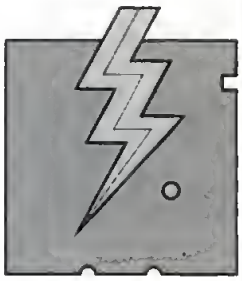
POWER USER



Make your network printer wait for a sheet of letterhead stationery; an easier way to find style sheets in Word; underline and bold WordPerfect text with one macro.

Here's a way to use *WordPerfect* 5.0 macros to locate hard-to-find characters

In preparing *WordPerfect* text for use with *Ventura Publisher* or other page-formatting software, many characters—such as typographic quote marks and em dashes—require special codes. Simple search-and-replace macros can handle some of these. However, hyphens that should be converted to en dashes between numbers (as in "pages 3–9") are difficult to search for.

WordPerfect 5.0's new macro language makes the job much simpler. The programming statements can be entered only in the built-in macro editor, however, so a macro must exist before it can be edited. The first step, therefore, is to define NDASH from the keyboard, using macro definition (Ctrl-F10). Then put in the initial search for a hyphen (F2, hyphen, F2) and end the macro definition. Now hit Ctrl-F10 again, give NDASH as the macro name, and elect to Edit the existing macro. Choose Action in the editor to edit the macro so that it exactly matches Figure 1.

The macro commands (such as LABEL, CASE, and GO) are entered by first pressing Ctrl-PgUp. This brings up a list of commands from which you choose the one you want. Normal *WordPerfect* commands can be entered by hitting the appropriate key combinations (F2 for search and Alt-F2 for search-and-replace, for example) or by first hitting Ctrl-F10 (which turns on function mode) and pressing the appropriate keys (such as Home-Home-Up). Pressing Ctrl-F10 again turns off function mode. To enter variable numbers, first press Ctrl-V, then hold down the Alt key and press the number of the variable (0 to 9). When finished editing, press F7 to exit (not in function mode).

Though not adequately documented in the manual, the new macro language opens up new possibilities for complex text processing in *WordPerfect*.—*Michael Conner; Kampsville, Illinois*

You can also use this technique in other macros that need to test whether a character belongs to a particular set of characters. The basic principle is the same: Block the character, assign it to a variable, and use a CASE statement that contains an entry for each member of the set.

Previously, I've been able to show you how to define macros simply by listing the keystrokes. Because of the advanced macro features of *WordPerfect* 5.0, however, that's no longer a viable method. Thus, you'll be seeing more and more macros here in which your instructions consist of a screen shot of the macro editor. If you haven't started using the macro editor, try it with some of the examples in this column.—*Neil J. Rubenking*

```
{DISPLAY OFF}
{LABEL}BEGIN~
{Search}·{Search}{;}Find·a·hyphen~
{Left}{Left}
{Block}{Right}
{Macro Commands}31{;}Put·the·character·before·it·in·VAR·1.~
{CASE}{VAR 1}~0~C~1~C~2~C~3~C~4~C~5~C~6~C~7~C~8~C~9~C~~
{;}If·the·char·is·any·NUMBER·go·to·C~
{GO}END~{;}...otherwise·go·to·END.~
{LABEL}C~
{Right}{Block}{Right}
{Macro Commands}32{;}Put·the·character·AFTER·it·in·VAR2.~
{CASE}{VAR 2}~0~N~1~N~2~N~3~N~4~N~5~N~6~N~7~N~8~N~9~N~~
{;}If·this·char·is·also·a·number,·go·to·N.~
{GO}END~{;}...otherwise·go·to·END.~
{LABEL}N~
{Left}{Left}{Del}<196>
{;}Delete·the·hyphen·and·replace·with·en·dash·code.~
{LABEL}END~
{Right}{;}Move·past·the·hyphen·and·search·again.~
{GO}BEGIN~
```

Figure 1: *This* WordPerfect *5.0 macro determines whether or not a hyphen is used as an en dash.*

You can underline and bold *WordPerfect* text in a single operation

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■ POWER USER

fect, but the macro below makes it a breeze. The macro takes advantage of the GoTo mode, which is turned on when the Block On is active. In this mode, the cursor will move to the next occurrence of any key that is pressed, marking the block up to this character. Thus, for example, you can simply press the Spacebar to mark a word, or hit the period key twice to mark two sentences.

You can also use the cursor movement keys to mark the block, of course. After the block is marked, press Enter to make the text underlined and bold. The macro keystrokes are shown in Figure 2.

Note that the keystrokes won't perform the expected function when you're defining the macro, because no block has actually been marked during definition.—*H. S. Chan; Penang, Malaysia*

This technique becomes even more interesting in *WordPerfect* 5.0, since there are many more text variations that you might want to combine. The macro shown in Figure 3 makes a block of text underlined, very large, and shadowed—admittedly, a bizarre combination—all at once.

As with Chan's 4.2 macro, the keystrokes won't do what you expect *during* the creation of the macro. Just press them in order and they will be recorded correctly. If there are special combinations of text attributes that you use often, create a macro like this for each combination.—*Neil J. Rubenking*

Here's how to make it easier to find your style sheets in *Word*

In one of his books on *Microsoft Word*, Peter Rinearson suggests that if you intend to start the program from more than one directory, you should put all your style sheets in a single directory reserved for them alone. This avoids cluttering your disk with a multitude of similar style sheets, and it ensures that if you update a style sheet in one place, all documents with that style sheet will be immediately updated.

Unfortunately, the use of a separate style-sheet directory means that each time you start a new document or open a new window, you have to tell *Word* where to find NORMAL.STY. This can be an irksome chore, but the following macro

```
<Ctrl-F10>                  Begin macro definition
UND&BOLD                    Call it UND&BOLD
<Alt-F4>                    Block On
<Ctrl-PgUp><CR><CR>         Pause to specify block
<F8>                        Underline the block
<Alt-F4>                    Block On again
<Ctrl-Home><Ctrl-Home>      Go to start of previous block
<F6>                        Make block bold
<Ctrl-F10>                  End macro definition
```

Figure 2: *This macro allows you to combine underlining and boldface operations.*

```
<Ctrl-F10>                  Begin macro definition
UND&MORE                    Call it UND&MORE
(description)               Enter description of choice
<Alt-F4>                    Block On
<Ctrl-PgUp>1<CR>            Pause
<Ctrl-PgUp>DN               Turn the display off
<Ctrl-F8>SV                 Set Size Very large
<Alt-F4>                    Block On again
<Ctrl-Home><Ctrl-Home>      Re-mark same block
<Ctrl-F8>AA                 Set Appearance shAdowed
<Alt-F4>                    Block On yet again
<Ctrl-Home><Ctrl-Home>      Re-mark same block
<F8>                        Underline the block
<Ctrl-F10>                  End macro definition
```

Figure 3: *The greater versatility of* WordPerfect *5.0 allows combining more text attributes. The macro above combines underlined, very large, and shadowed specifications in a single operation.*

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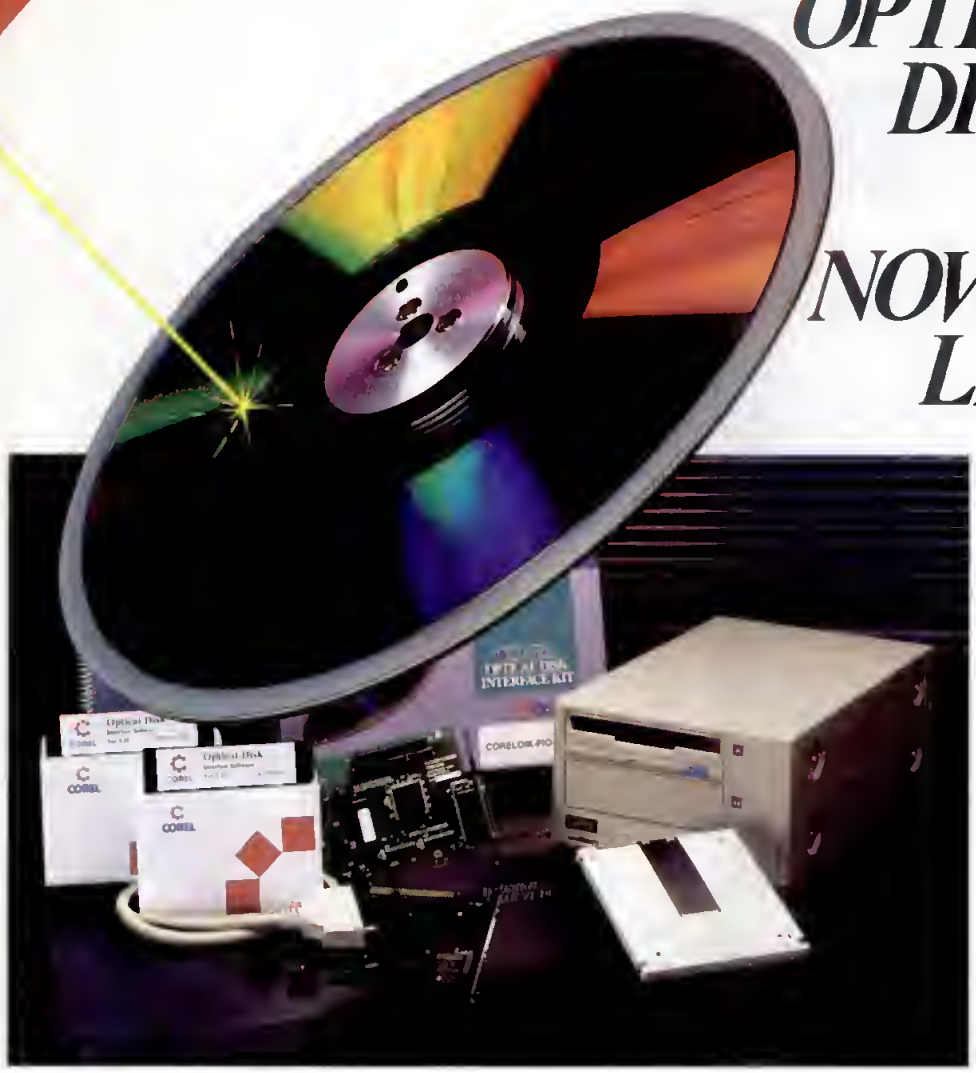

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CIRCLE 494 ON READER SERVICE CARD

■ POWER USER

makes it easy to attach a style sheet from a common directory:

```
<ctrl esc>fsac:\ss\<f1>
```

This ends with the list of style sheets on-screen, so that you have to choose only the one you want.—*Albert Delfiner; Eastchester, New York*

As written, the macro assumes that the style-sheet directory, SS, is in the root directory. A better choice would be to put it in the *Word* directory so you don't clutter up the root.

Also keep in mind that maintaining a separate style-sheet directory is not the only reasonable choice. One obvious possibility is simply to keep all style sheets in the *Word* directory, where the program expects to find them. Granted, this adds more files to an already crowded directory, but when you use the Format Stylesheet Attach F1 command, *Word* will show only files with an STY extension.

Another possibility is to keep most style sheets in a single directory but create special style sheets for directories that naturally require unique styles. For example, if you keep a correspondence directory that contains all of your letters, it makes more sense to have a special NORMAL.STY for letters in that directory than to have a separate LETTERS.STY in the style-sheet directory.

If you use this trick, then whenever you start a letter in the correspondence directory, *Word* will automatically load the NORMAL.STY for letters. When you load files in other directories, *Word* will automatically load the NORMAL.STY from the *Word* directory. You should use this approach sparingly, however, since you can quickly confuse yourself by creating multiple style sheets, all of which have the same name.—*M. David Stone*

How to tell your network printer to wait for a sheet of letterhead stationery

Our office uses *WordPerfect* in a network environment where 30 people share two HP laser printers. A request to print on letterhead used to signal the start of a departmental relay race. On your mark (load tray with letterhead). Get set (send print job). Go (grab printout—often someone else's—on your letterhead).

The solution was to write a macro to pause the printer and request a manual sheet feed. Simply enter the keystrokes shown below to assign the macro to Alt-L (for letterhead). Naturally, any legal macro key or name may be used.

```
<Ctrl-F10>          Start Macro Def.
<Alt-L>             Call it Alt-L
<Home><Home><Up>    Go to top of Doc.
<Ctrl-F8>A          Insert printer Cmd.
<27>&l2H               Cmd. for manual feed
<CR><CR>               "Enters" command
<CR>                   *See Note below
<Ctrl-F10>          End macro Def.
```

(Note: You must have at least one blank line for the command to work correctly. You may add additional blank lines to avoid printing on your letterhead.)

When your document prints, the printer will eject a blank sheet and then pause with the message "PF FEED LETTER." You should then insert your letterhead. Only the first page will print on letterhead; the remaining pages will print on whatever is in the paper tray.

One additional note: The printer command that requests manual feed is saved with your document.—*John Grundy; Mesa, Arizona*

Of course, you may have to modify the macro above to match your particular laser printer's command sequences. Check your manual to see what the code to request a manual feed is, and substitute it for the <27>&l2H in the macro. *WordPerfect* 5.0 users can easily create a corresponding macro by following the comments rather than the exact keystrokes.—*Neil J. Rubenking*

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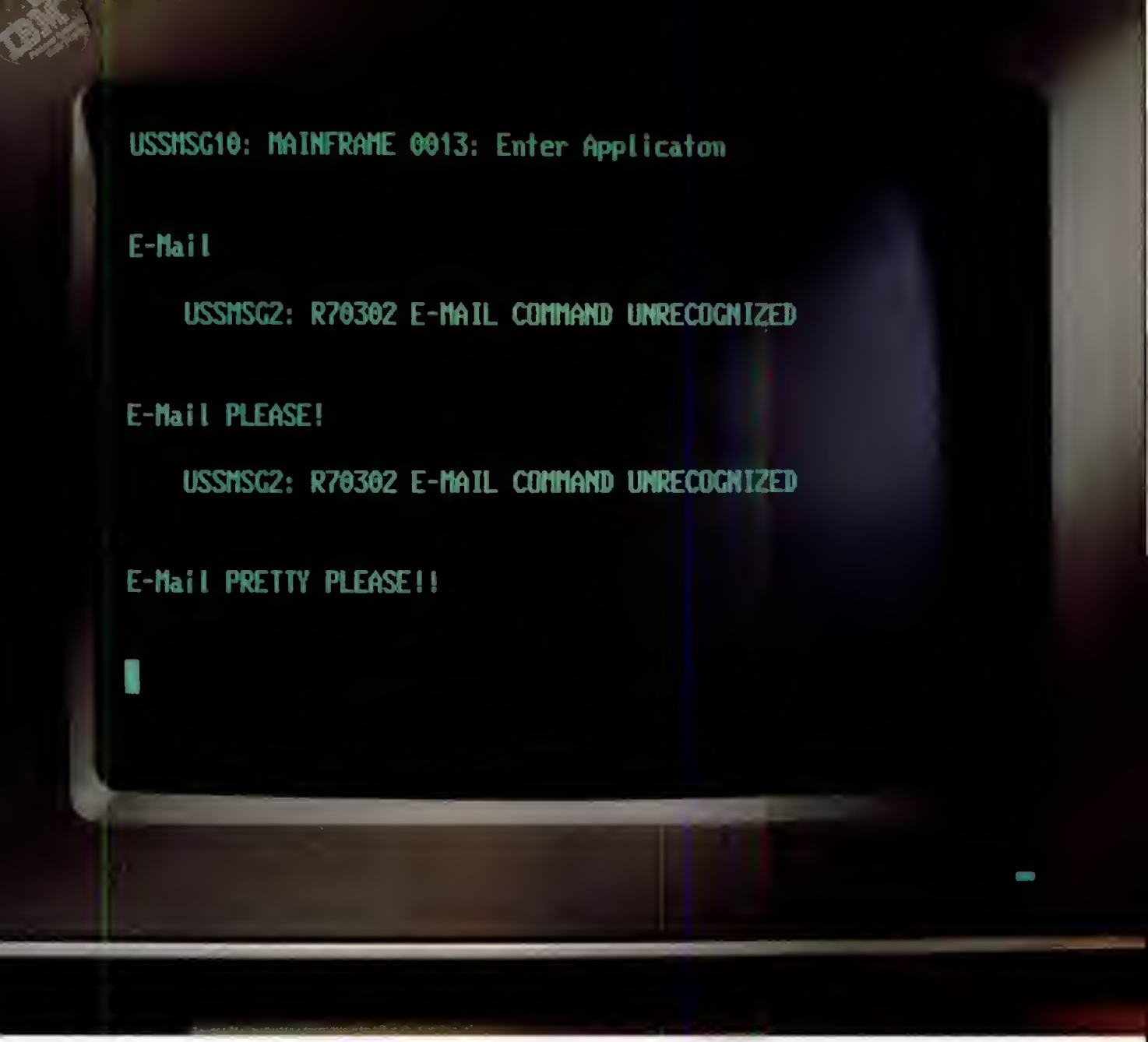

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CIRCLE 124 ON READER SERVICE CARD

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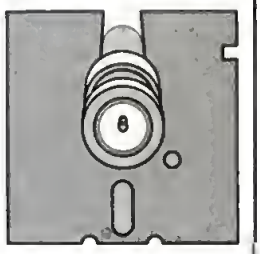

The difference between software that is usable on a LAN and software that uses a LAN; some data switches don't just deliver mail—they read it; a PC LAN Labs free T-shirt offer.

A data switch can spoil protocol file transfer attempts

We recently switched from dial-up lines to a multiplexor with leased lines to communicate with the DEC VAX minicomputer at the home office. It has been a big improvement, except that I can no longer transfer files. Why, when we are no longer getting garbage on the lines and everything else seems to work, do file transfers fail?—*William Jarman; Great Falls, Montana*

A multiplexor is a sophisticated form of data switch that packs the equivalent of several telephone or data lines together and sends the information economically over lines leased from a telephone company. A multiplexor is closely related to the data PBXs or data switches that I tout so highly as connectivity alternatives in many installations. The trouble with some of these systems (they're not all alike) is that they don't just pass along the mail, they insist on reading it first!

You didn't specify what file transfer protocol you were using, but I'll bet it is some form of Xmodem. Many file-transfer protocols (such as Xmodem) may send special characters such as XOFF and XON (decimal 19 and decimal 17) as part of the data in the file. These are control characters and are frequently interpreted as instructions by the multiplexors or data switches. As such, they have unintended functions and are essentially "eaten up" by the switch.

File transfer protocols such as Kermit avoid troublesome control characters and should provide a solution. Xmodem is unsuitable for a variety of reasons. Usually it cannot be used over a multiplexor connection or over X.25. It doesn't have a configurable block size and it alters the size of files, rounding them up to the nearest 128 bytes. In addition, it performs no data compression—a feature that sometimes allows effective data-transfer rates greater than the actual bps rate of the line.

Not all software on a network is networked

I'm helping plan a local area network using *NetWare* over 3Com EtherLink adapter cards. Can you explain what's the difference between software that is usable on a LAN and software that uses a LAN? Do we have to get new application software for everything we do? Also, what's the best way to let people remotely control stations on the LAN?—*Eric R. N. Hall; Atlanta, Georgia*

■ Most normal single-user software will work on a LAN as well as on a single-user PC, as long as it is used by only one person at a time.

Most normal single-user software will work on a LAN as well as on a single-user PC, as long as it is used by only one person at a time. This kind of software doesn't use the LAN services. It just resides on one of the LAN's logical disk drives, where it also stores its data.

LAN programs let you "map" part of the server's disk space so it looks like a local disk drive to your operating system and your software. The application software neither knows nor cares that drive C: is on your desk, while drive G: and the laser printer are down the hall.

This is the way most people use application software on a network. Standard DOS programs are perfectly happy this way unless more than one person tries to use the same files at the same time. In practice, most people put their programs and files in private subdirectories on the server and put only shared data files in public directories.

You can get remote-control dial-in access to a LAN using software such as Crosstalk Communication's *Remote*^{2}. Remote-control software runs on a modem-equipped PC on the LAN. Users can dial into this PC and use the remote-control program to log on to the LAN. The remote-control program doesn't care that drive G: is down the hall either—it's just handling the modem and rerouting the console I/O to the modem.

■ CONNECTIVITY CLINIC

Software that *uses* a LAN for something more than simple data storage and print spooling is a little more complex. It must be tailored to the type of LAN you're using, since the facilities available and the methods necessary to use them vary from LAN to LAN.

Most LANs have multiuser facilities such as record locking to prevent two users from simultaneously changing the same record in a database. However, they are available only to the applications written to use them. Other LAN services, such as NetBIOS and IPX, provide interstation communications, making it possible for application programs that are running on separate workstations to coordinate their activities.

This type of intraLAN, interstation communications facility can be exploited by some remote-control products, too. *Remote²LAN* (also by Crosstalk Communications) uses the LAN's communications capabilities, allowing one LAN workstation to serve as the remote console for another LAN workstation. In this arrangement, all communications go over the LAN and no modem is used. On a large LAN, this

■ Most LANs have multiuser facilities such as record locking to prevent two users from simultaneously changing the same record in a database.

would allow a central help desk to investigate problems experienced by people using the LAN without requiring additional hardware or phone lines.

Although you usually think of "resource sharing" on a LAN in terms of disk drives and printers, over-the-LAN remote-console software allows network users to share a single-user application as a resource, too. A CD-ROM-based research package, such as Ziff-Davis's Computer Library, is a perfect example of this type of resource. Running Computer Library's *Lotus BlueFish Searchware* under *Remote²LAN*'s control not only shares the CD-ROM drive as a resource but shares the software that uses it, too. When it is run in this fashion, any user on the LAN can use the nominally single-user Computer Library software to search the abstracts and full-text articles on the CD-ROM; the users just make a "call" over the net with *Remote²LAN*.

Report the activity of your Novell network to PC LAN Labs and get a free T-shirt

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ATOTAL compiles data from the accounting system, so you have to use the first selection in the SYSCON menu to turn on the accounting function. Additionally, you have to assign charge rates to the five different services monitored by the accounting system. (See pages 4-9 of the *Supervisor Reference* manual.)

A word of warning, however: you *must* enter the Supervisor Options menu under SYSCON, choose the Default Account Balance/Restrictions menu, and give everyone a default of unlimited credit. (See pages 4-14 of the manual for details.) If you don't do this, all of your users will be locked out of the network. This is likely to make you so unpopular that not even our T-shirt can help.

At the end of one week, run ATOTAL and print the screen. The accounting system doesn't post results until after a user logs off, so run the report when most people are off the system. Send the printout to PC LAN Labs, P.O. Box 6009, Destin, FL 32541. Remember to tell me to what address I should send the T-shirt.

The ATOTAL report won't give us a picture of the peak load. If you can find a way to show us the load during a peak period, I will also send you some of our high-quality PC LAN Labs drinking cups—the same ones we use on the Destin beaches.

Productivity Tip

Are you interested in improving LAN performance? Before you buy a high-speed 386 machine for a file server, take a look at your present server's hard disk drive. Then, simply buy a bigger, faster drive or put in multiple drives. Server processors typically loaf along while the drive screams.

Network Your Questions

Connectivity Clinic gives you practical solutions to networking problems of all types. We'll pay $50 or more for any tips we print, *plus an extra $25 if you submit your letter on a disk*. If you do, please include a printed copy. We'll gladly answer your questions at no charge, but we cannot answer letters personally. Mail contributions to Connectivity Clinic, *PC Magazine*, One Park Avenue, New York, NY 10016, or upload them to PC MagNet (to join, see the "By Modem" sidebar in the Utilities column). You may also contact Frank J. Derfler, Jr., via MCI Mail (use Derfler's box named CONNECTIVITY CLINIC).

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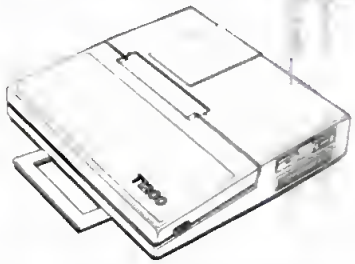

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Everex 2400 External	$199
US Robotics 2400 Int.	$169
Sharp FO-220 Fax	$825
Sharp FO-300 Fax	$1099
Sharp FO-420 Fax	$1199

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EPSON

LX 800	$169	LQ 500	$275
DFX 5000	$1349	LQ 850	$515
FX 850	$339	LQ 1050	$715
FX 1050	$429	LQ 950	$579
EX 800	$379	LQ 2550	$909

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ML 390	$469	ML 391	$639
		393	$999

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351 SX	$959

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1524	$559	1595	$449

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Ext. 5¼" for PSII	$179	***SEAGATE HARD DISKS***	
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Vega VGA	$269

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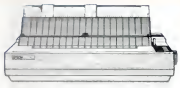
Epson FX-850

- Narrow-carriage 9-pin, dot-matrix printer.
- SmartPark,™ a unique Epson paper-handling innovation, lets you switch from fanfold to single sheets or envelopes without removing hardware or paper.
- With a standard push feed tractor and single sheet friction feed, the FX-850 can handle virtually any type of paper as well as envelopes.
- Exclusive SelecType front control panel puts popular printer features and SmartPark operations at your fingertips.
- The FX-850 prints 264 characters per second (CPS) in high-speed draft mode (12 CPI); 54 CPS in Near Letter Quality mode (12 CPI).



Epson FX-1050

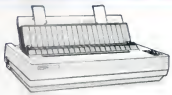
- Wide-carriage 9-pin, dot-matrix printer.
- SmartPark,™ a unique Epson paper-handling innovation, lets you switch from fanfold to single sheets or envelopes without removing hardware or paper.
- With a standard push feed tractor and single sheet friction feed, the FX-1050 can handle virtually any type of paper as well as envelopes.
- Exclusive SelecType front control panel puts popular printer features and SmartPark operations at your fingertips.
- The FX-1050 prints 264 characters per second (CPS) in high-speed draft mode (12 CPI); 54 CPS in Near Letter Quality mode (12 CPI).

Epson LQ-500

- Epson's 24-pin, dot-matrix technology creates true letter quality characters and high-resolution graphics
- Prints 180 characters per second (CPS) in draft mode; 60 CPS in letter quality (12 CPI)
- Automatic single sheet loading, standard pull tractor and friction feed for versatile paper handling
- Exclusive SelecType front control panel offers quick, easy selection of popular typestyles, fonts and pitch
- Two resident, letter quality fonts — Roman and Sans Serif
- New "shadow" and "outline" print modes for use with desktop publishing applications

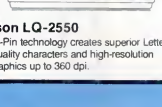
Epson LQ-850

- Epson's 24-pin, dot-matrix technology creates true letter quality characters
- Epson's SmartPark ™
- Exclusive SelecType front control panel offers quick, easy selection of popular typestyles, fonts and pitch
- 264 Characters per second in the high-speed draft mode delivers outstanding productivity
- 88 Characters per second in Letter Quality mode for enhanced, high-resolution characters
- In draft mode or Letter Quality mode, the LQ-850 runs at a surprisingly quiet 55 dB noise level



Epson LQ-1050

- Epson's 24-pin, dot-matrix technology creates true letter quality characters
- Epson's SmartPark ™
- 264 Characters per second in the high-speed draft mode delivers outstanding productivity
- 88 Characters per second in Letter Quality mode for enhanced, high-resolution characters
- In draft mode or letter quality mode, the LQ-1050 runs at a surprisingly quiet 55 dB noise level
- Exclusive SelecType front control panel offers quick, easy selection of popular typestyles, fonts and pitch



Epson LQ-2550

- 24-Pin technology creates superior Letter Quality characters and high-resolution graphics up to 360 dpi.
- 7-Color printing capability is standard.
- Epson's SmartPark ™
- Exclusive LCD SelecType front control panel for easy selection of pre-sets, fonts and printer functions.
- 133 Characters per second print speed in Letter Quality mode (12 CPI).
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PP256 Pictured

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NEW!

QC1478 Pictured

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ST238AT	30MB w/Controller (AT)	$329.95
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ST251AT	40MB w/Controller (AT)	$489.95
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ST225XT Pictured

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JE3025 Pictured

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JE1022 Pictured

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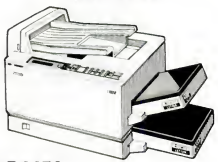

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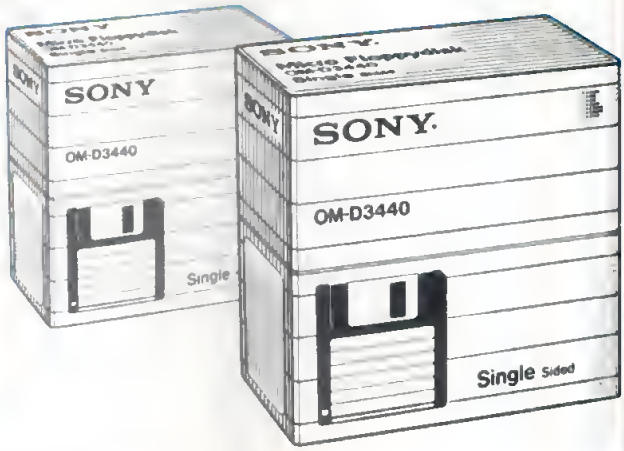
5-300XLP-S	QD300XLP	18.75
5-QD600XTD-S	QD600XTD	20.49



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Media from the Surface Scientists

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1K38A13	3.5" DS Bulk	1.12	1.07
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1L55A14	5.25" DS/DD Bulk	.43	.39
1L57A11	5.25" DS/HD Boxed	.99	.89
1L85B31	8" DS/DD Boxed	1.39	1.29

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- 16-bit EGA; operates at 12.5 MHz
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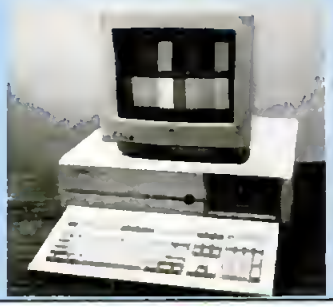

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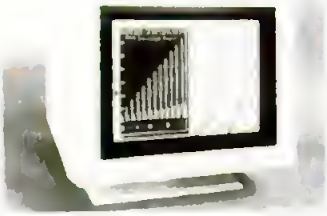

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Rebates end May 31

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DFX-5000		CALL

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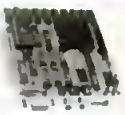

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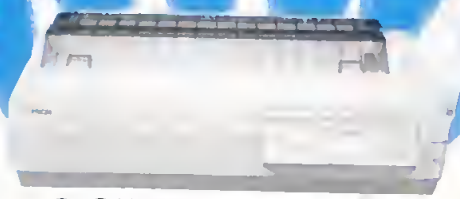

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- SmartPark paper-handling

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- Wide carriage 9-pin, dot matrix printer
- 264 CPS-high speed draft 54 CPS-NLQ
- SmartPark paper-handling

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- 9-pin printhead
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- Parallel interface

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- 24-pin printhead
- 136 column
- 264 CPS-draft, 88 CPS-LQ

LQ-500

- 24-pin dot matrix printer
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- 180 CPS-draft, 60 CPS-LQ

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102	Brother M1409	5.05
127	Brother M1509/1709	5.75
131D	Burroughs B-8246-3/8	5.45
104	Canan A-1200	4.95
113	Cantronics 150/152	2.45
109	Cantronics 350/351/352/353	9.35
112	Cantronics 704/705/753	4.95
118	Citizan LSP 120D/180D	4.95
189	Citizan MSP 10/20	2.75
187	Citizen MSP 15/25	3.85
123	Comrax 420	7.55
114	C. Itoh 1550/7500/8510	3.25
120	Date Ganaral LP2	8.35
130	Data Products M-100L/120/200	3.85
131D	Data Products B-300/800	5.45
137	Data Products B-900/1000	7.15
135	Data Royal 5000	2.85
990	Datatrol/LRC MP40	4.55
135	Data South 180/220/5180	2.85
160	Dac LA 34/100/210 Latterprinter	3.25
114	Dac LA 50	3.25
156	Diablo 1660/2300 Matrix	3.85
153	Diablo Hytypa II Nylon	3.25
280	Epson EX 800/1000	4.65
185	Epson FX/MX/RX 70/80/85	2.75
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163	Epson Lq 1500	3.25
281	Epson Lq 2500 H.D.	4.95
283	Epson Lq 2550	4.95
175	Epson LX 80/80	2.75
226	Facit 2301/4512/4514	3.25
133	Facit 4500/4510/4511/4513	4.15
135	Facit 4520/4525/4528/4528	2.85
991	Fujitsu DMPG 9/DX2100-2200	4.35
146	Hawlatt Packard 2608	20.55
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114	NEC 8023 PC/8024 PC/8027 PC	3.25
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262	Star Micronics Radix 10/SR 10	3.95
263	Star Micronics Radix 15/SR15	4.55
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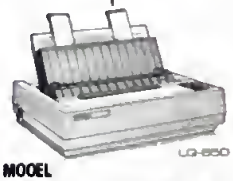

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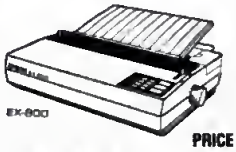

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FX-1050	9 pin	136 col.	CALL	LQ-950	24 pin	110 col.	CALL
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293 PLUS	240cps	136 col	CALL	LASER LINE 6	LASER PRINTER		CALL
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(Prints 11 pages per minute. Standard RS-232C serial and Centronics parallel ports. 512K RAM memory, upgradeable to 1.5 MB.)

ATI Technology you can trust

Video Boards

ATI-V101 VGA	271.00
VGA Wonder 256K	310.00
VGA Wonder 512K	395.00
ATI Wonder 800	229.00

Modems

ATI2400 ETC	165.00

PACIFIC Data Products

Font Cartridges

25 cartridges in 1	298.00
(103 fonts)	
Plotter in a cartridge	269.00
(HPGL™ emulation for laser printer.)	

Memory Boards

1 MB	361.00
1 MB for HPIID	485.00
2M II & IID	800.00
4M II & IID	1550.00

In Touch with Tomorrow
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Facsimilies

T-30100	995.00
T-3300	1175.00
T-3700	1450.00

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CIRCLE 537 ON READER SERVICE CARD

Leprecard Hard Disk Cards

Tandy 1000 Model

NOW for AT

TakeTwo

Leprecards feature components utilizing the latest technology. You can use them as the first or second hard disk in your system. Low power drives mean less strain on your system. You get a 1 year warranty, unlimited technical support, & our illustrated installation and user's guide. Models available for IBM PC/XT and compatibles, AT's and compatibles, as well as the TANDY 1000/A/SC/TX/TL/SL.

***FREE SOFTWARE** including **TakeTwo**, the backup utility PC MAGAZINE named Editors choice in 1986 & 1987. Also included is PC-KWIK disk caching from Multisoft.*

COMPUTER TYPE	21MB 40MS	32MB 40MS	49MB 40MS	65MB 16MS
8 BIT PC/XT	$299	$319	$479	$599
16 BIT PC/AT	N/A	$379	$549	$639

HIGH PERFORMANCE SCSI DRIVES	21MB 40MS	32MB 40MS	49MB 40MS	60MB 24MS
	$349	$379	$399	$669

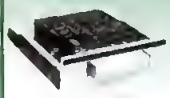
DFI Handy Scanner

$219

- 4½" scan width, 400 dpi resolution
- 16 grey scales, 8" per second speed
- Comes with short slot controller & 71" cable
- Use with Hercules, CGA, EGA, & VEGA displays
- Scan images for Fax
- Optional OCR Software available
- Includes HALO DESKTOP PUBLISHING EDITOR software

Jumbo Tape Backup

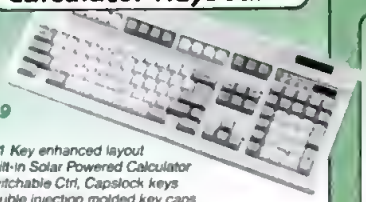
COLORADO MEMORY SYSTEMS



$299
(with Tape Cartridge)

- 40 8 Megabytes per DC2000 tape cartridge, one tape included
- Connects to floppy disk controller
- Uses standard QIC-40 format
- 2MB per minute in AT's, 1MB/min in PC/XT
- External chassis available
- Novell, 3COM & SCO Xenix Compatible
- **DC2000 Cartridges:** $22 ea./5 for $110

Calculator Keyboard



$89

- 111 Key enhanced layout
- Built-in Solar Powered Calculator
- Switchable Ctrl, Capslock keys
- Double injection molded key caps
- Removable function key template
- ALPS tactile keyswitches as used by Northgate
- 100% PC/XT/AT/386 & Novell network compatible

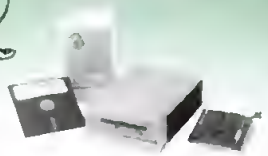
3.5" Floppy Kits

*3.5" **External** Floppy Drive, $299*

External High Density 1.44MB Floppy Drive for PC/XT Computers.

The easy way to transfer PS/2 data between systems. Includes replacement high speed controller, cables and manual.

***FREE: TakeTwo**, the backup utility PC MAGAZINE names as their Editor's Choice. Now you have a fast, affordable backup solution that brings you media compatibility with the latest IBM PS/2 systems.*



720K Internal for PC/XT/AT. $109
- Requires DOS 3.2 or optional $15 driver software.

1.44MB Internal for AT only $139
- Includes driver software

1.44MB Internal for PC/XT $199
- Floppy Controller & cables with 500,000 bit/second data transfer rate. Supports 2 drives

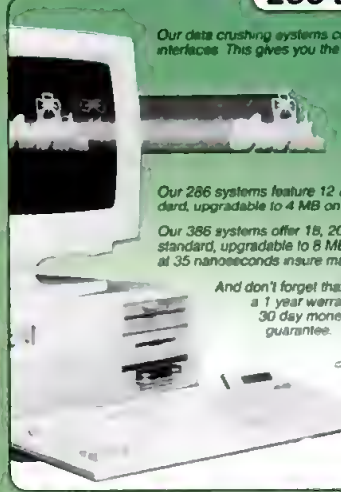
Instant Laptop & PS/2 compatibility. All kits include bracket to mount in 5¼" drive bay, black & grey face plates, and mounting rails. 144MB XT kits include replacement floppy controller that doubles the data transfer rate.

AT Disks

- Seagate Drive with IBM AT rails & cables
- **SpeedStor** or **OnTrack** large drive software
- Formatted, Partitioned & Tested

Size	Model	Speed	Format	Capacity	Price
HH	ST251	40ms	MFM	48MB	$359
HH	ST251-1	30ms	MFM	42MB	$449
HH	ST277R	40ms	RLL	65MB	$499
FH	ST4096	28ms	MFM	80MB	$599

286 and 386 Computers



Our data crushing systems come standard with high performance SCSI disk interfaces. This gives you the data transfer capabilities required by this high performance generation of systems. All our computers have 8 slot motherboards, room for 1 full and 3 half-height drives, serial/printer ports, AWARD BIOS, clock/calendar, choice of 1.2 MB or 1.44 MB floppy drive, and LepreKeys Enhanced Keyboard with tactile switches and built-in solar calculator.

Our 286 systems feature 12 & 16 MHz processors and 512K RAM standard, upgradable to 4 MB on system board.

Our 386 systems offer 16, 20 & 25 MHz processors and 1 MB RAM standard, upgradable to 8 MB. A 64K static column RAM cache operating at 35 nanoseconds insure maximum processor performance.

And don't forget that when you buy from Shamrock you get a 1 year warranty and 30 day money back guarantee.

COMPARE OUR DOWN TO EARTH PRICES AND EXCEPTIONAL PERFORMANCE

SYSTEM	NORTON SI	MIPS	PRICE
Shamrock 286-12	11.8	1.0	$ 599
Shamrock 286-16	15.9	2.0	$ 699
Shamrock 386-16	18.7	2.0	$1,799
Shamrock 386-20	24.4	4.3	$1,999
Shamrock 386-25	30.5	5.0	$2,799

SCSI DRIVES	PRICE	VIDEO OPTIONS	PRICE
Seagate ST225N 20 meg 65 ms	$299	Monographics Card & Monitor	$139
Seagate ST251N 40 meg 40 ms	$399	VGA Card & Multiscan Monitor	$669
Seagate ST277N 65 meg 40 ms	$469	16 Bit **High Speed** VGA Card & Multisynch 2A	$899
Seagate ST296N 80 meg 40 ms	$549		

Seagate SCSI Kits

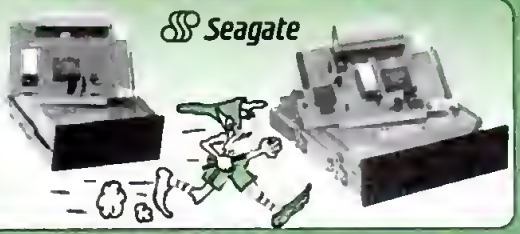
The Small Computer Systems Interface (SCSI) provides increased performance, reliability and flexibility over ST412 drives. Performance is improved through improved transfer rates, built-in 1:1 interleave capability, and automatic error detection and correction.

Shamrock SCSI kits are compatable with all 8088, 286, 386, PS/2 Model 24, 30, and 30/286 systems.

*Each kit includes high speed SCSI Hard Drive with face plate, host adapter, installation guide with menu driven software, and mounting hardware. Bundled software includes the **TakeTwo** backup utility and **Lepreca**che disk cache software. Specify computer when ordering.*

Seagate Model	Size	Formatted Capacity	Average Time	Kit Price
ST225N	5.25"	20MB	65 msec	$329
ST138N	3.5"	30MB	40 msec	$369
ST157N	3.5"	49MB	40 msec	$389
ST277N	5.25"	64MB	40 msec	$499
ST296N	**5.25"**	**80MB**	**28 msec**	**$559**

For ST02 Combination SCSI Hard/Floppy Controller add $40



Seagate PC/XT Disk Kits

- Pretested & formatted
- Western Digital short slot controller
- 30 page installation guide & reference manual
- Cables, mounting screws, full & half-height face plates
- FREE! **TakeTwo** high speed backup software. PC MAGAZINE "Editors Choice"
- FREE! **LepreCache** software by Multisoft
- 1 year Warranty. 30 Day Money Back Guarantee
- Optional 150 Watt UL/FCC approved power supply for IBM PC's $69

Tandy 1000 kits add $20

NEW

3DMB KIT $299 (Seagate ST238)
- 32.7MB/65ms/Half Height/14.8 watts

65MB KIT $499 (Seagate ST277R)
- 65.5MB/28ms/Half-Height/11 watts

Seagate Matched Pair Kits — 20MB $249, 40MB $349
- Seagate Drive & Matched Controller
- 1 year factory warranty
- 15% faster throughput than ST251 drive

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MP 286L-220 2349

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MultiSpeed HD 2299

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Includes 3' or 6' cable
With Purchase of Any Laptop .. 269

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T1000: Toshiba's lightest & smallest
T1200HB: 20MB with backlit screen, battery
T1600: 12MHz, 20MB w/backlit EGA screen, battery
T3100E: 12MHz, 20MB w/IBM compatible half slot
T3200: 40MB, 2 IBM Compatible slots
T5100: 16 MHz, 40MB w/EGA gas plasma screen

MITSUBISHI

MP286L-210 2 floppy	1999
MP286L-220 1 floppy, 20MB	2349
Carry Case	99
Floppy 5.25" Ext 360k	299
Memory Card 2MB	999
Modem 2400 Int	349
Numeric Keypad	129

NEC LAPTOPS

NEC MultiSpeed EL II	1499
MultiSpeed HD w/20 MB	2299
Battery Pack-Specify EL or HD	99
Car DC Cable-Specify EL or HD	30
Carry Case	99
Floppy 5.25" Ext 360K for HD	299
Modem NEC 1200 Int	249
Modem NEC 2400 Int	349

LAPTOP ACCESSORIES

★ Specify Laptop Model ★	
AC Adapter: T1000/1100+	69
AC Adapter: T1200/1600	99
Auto Adaptar T1000/1100+	59
Battery Charger: T1200/1600	239
Battery Pack T1200/1600	79
Carry Cases by Toshiba	
Fabric: T1000/1100/1200	59
Fabric: Othar Modals	99
Leather T3100/3200/5100/5200	249
DESIGNER Carry Case w/pockets for SW, manuals, portable printer etc.	
Specify modal	149
Expansion Chasis	929
WonUnder Single expansion slot	269
WonUnder II: Two slots	369
Floppy 5.25" External: 360k/1.2MB	299/349

MEMORY EXPANSION

T1000 768K Card	249
T1200 1MB	649
T1600 2MB	1099
T3120 1MB	649
T3100E 2MB	1099
T3200 3MB	1299
T5100 2MB	1099

MODEMS: FOR MITSUBISHI, NEC & TOSHIBA LAPTOPS (Except T1000/3200)

Toshiba 1200 Int	269
Toshiba 2400 Int	299
Megahertz 1200 Int	149
Megahertz 2400 Int	199
Prometheus 2400 Int	199
Adaptamodem 2400 Int	229
World Port 1200 Ext	159
World Port 2400 Ext	259
Toshiba cable for Ext Modems	20
Numeric Keypad: T1200/T1600	99
Laplink Plus	99

PRINTERS

ALPS Allegro	379
ALO 224E	629
ALO 324E - Wide Carriage	699
★ DICONIX InkJet 150 parallel with 3' or 6' cable	299
with any Laptop	269
NEC P2200 Parallel	329
5200/5300	499/659
Color Kit 5200/5300	109
PANASONIC 1592	369
1595	399
TOSHIBA 311	NEW
321 SL	$ TOO LOW
341 SL	TO PRINT
KENSINGTON Printer Stand	20
★ With Printer	10 ★

DRIVES & BACKUP

PLUS HARD CARD: 20 MB	499
40 MB	629
TOSHIBA 3.5" Internal with Universal mounting kit 720K/1.44 MB	99/109
SEAGATE: For PC/XT HALF HT	
PRO PACK 20 MB (ST 225)	285
PRO PACK 30 MB (ST 238)	299
Fully Pretested, PRO PACK includes controller, cables, detailed & illustrated manual	
PC/XT Mtng Kit & Filler Plate	10

SOFTWARE BONANZA

All software is factory sealed & comes complete with manuals

BATTERY WATCH Ver 1.0 - 3.5"	39
BITCOMM 3 Ver 3.5 - 5.25"	29
BORLAND Sidekick: Specify 5.25 or 3.5	35
CARBON COPY Plus Ver 5.0-5.25"	69
GEM GRAPH 5.25"	49
LAPLINK PLUS	99
LOGI Paint/LOGI Cadd	29/49
LOGITECH Publisher	49
LOTUS Metro 3.5" Ver 1.0	29
PC PAINT Plus - 5.25"	29
EASY by MicroPro Ver 1.5-3.5"	49

FAX MACHINES/BOARDS

SHARP FO-220	649
SHARP UX-180	869
SHARP UX-350	1199
MURATA M1200/M1600	629/729
QUADRAM JT Fax Board 4800	279
JT Fax Board 9600	549
JT Fax Portable 4800	349
THE COMPLETE PC	
Fax Board 4800	249
Fax Board 9600	469

MONITORS

LOGITECH AutoSync with EGA Card, LogiMouse & Paint Show	569
MITSUBISHI D Scan 1371	429
Diamond Scan 1381	479
Diamond Scan Tilt & Swivel - add	20
NEC 1403-Super VGA 2A	499
1404 MultiSync 3D	699
MultiSync PLUS	699
SONY 1311CR-13" Trinitron Color Remote TV & RGB Monitor	549
Sony 1311 to IBM Cable	20
SONY Multiscan 1303	549
SONY Multiscan 1302	649
Sony 1303/2 to IBM Cable	20
Sony 1303/2 to MAC II Cable	30
ZENITH ZCM-1490 Flat Screen	599
Zenith Tilt & Swivel	30
UNIVERSAL Tilt & Swivel	20

KEYBOARD/MOUSE

KEYTRONIC 101 Plus Professional for PC/XT/AT	109
OEM Version: Identical to 101 with 90 day warranty from us	79
Keytronic Mouse Bus or Serial	99
LOGITECH PS/2 Mouse	75
C-7 Serial or Bus	85
HiRez Bus	89
Serial w/Clear Case	99
Logitech Publisher	49
LogiPaint/LogiCadd	29/49
MICROSOFT Mouse Bus or Ser	109
With Windows	149
MOUSE SYSTEMS w/PC Paint Plus Serial or Bus	99
QUADRAM Optical Mouse	79

MATH/RAM CHIPS

64K RAM 120 ns Set of 9	30
256K RAM	CALL
80C87-2 PC/XT 8 Mhz	139
80287-8 AT 8 Mhz	215
80287-10 AT 10 Mhz	239
80387-16 for 386 machines	379
80387-20 for 386 machines	469
80387-25 for 386 machines	599

MODEMS

Also See Under Lap Tops

HAYES 1200B Internal - with SmartCom II	275
TOUCHBASE SYSTEMS World Port Pocket 1200 Ext w/AC Adapter	175
2400 External with AC Adapter & Carbon Copy Plus	275
ZOOM 2400 Internal w/sw	129
2400 External w/sw	149

DISPLAY CARDS

ATI VGA Wonder (256k)	319
GENOA SuperEGA HiRes+ Version 4880-9	199
ORCHID Pro Designer VGA	329
Pro Designer VGA Plus	429
PARADISE VGA Plus	269
Paradise VGA Plus 16	299
Paradise VGA Professional	499
VIDEO-7 Vega VGA	269
FastWrite VGA	339
Vega V-RAM VGA (256k)	499
ZENITH Z-449	249
9 to 16 Pin Connector-Required for some Monitor/Card combinations	20

SUPER SPECIALS

★ PREPAID BY CHECK ONLY ★
★ POSTMARKED BY MAY 30, 1989 ★

MITSUBISHI D Scan 1371 w/Tilt&Swivel	435
SHARP FO-220	799
GENOA SuperEGA HiRes+(4880-9)	180

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714-897-2100

PLEASE REFER TO AD # PC 915

FASTMICRO

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1-800-441-FAST

SPECIALS

RGB Color Monitor
by Samsung

$199

These 14" monitors were purchased from a large PC manufacturer who was overstocked. They are brand new with one year warrantees and are made by Samsung. They are fully CGA compatible and work with PC compatibles. A CGA (640 x 200 resolution) card is just $49 and comes with a printer port. This is the perfect video combo for your new XT or AT clone.

WordPerfect 5.0

$215

The most popular word processor is now even better than ever! Version 5.0 adds multiple font support, graphics integration, page preview and much more. WordPerfect 5.0 still retains its feel and ease of use that made it #1. Combine this with the best support in the industry and you can't lose.

FoxBASE+

$185

FoxBase+ 2.10 is simply the fastest dBASE compatible database software available. FoxBase+ also adds many enhancements to the dBASE language. And it's user-friendly too, its FoxCentral uses pull-down and pop-up menus and you can perform every important database operation without programming! There are even LAN, runtime, and 386 FoxBase versions available.

HARDWARE

PRINTERS

	LIST	FAST
ALPS		
Allegro 24	499	315
Citizen		Call
Diconix		
150P	499	299
Epson		Call
Fujitau		
DL3400	995	549
NEC		
P2200	569	339
P5200	799	509
P5300	1049	669
LC890	4799	Call
Okidata		
182 Plus	319	219
320	499	329
390	699	469
393	1499	949
Panasonic		
KXP1180	300	Call
KXP1191	400	Call
KXP1124	529	309
KXP1595	749	419
KXP1524	949	519
KXP4450	2595	1479
Star		
NX1000	289	169
NX2400	499	299
Toshiba		
P321SL	749	459
P341SL	999	599
P351SX	1499	929

FAX MACHINES

Murata M1200	899	699
Murata M1600	1599	849
Toshiba 30100	1396	949

BOARDS

	LIST	FAST
AST		
Hot Shot 286	645	339
Six Pek Plus 64K	210	119
Everex		
1200B Int Modem	149	69
2400B Int Modem	249	129
EVGA	499	249
Genoa		
Super EGA Hi-Res+	399	179
Super VGA #5100	445	239
Super VGA #5300	499	299
Super VGA #5400	699	419
Hercules		
Graphic Card +	299	169
Intal		
8087-2	250	139
80287-10	480	249
80387-20	730	449
Above Board Plus	795	395
Orchid		
ProDesignar	499	297
ProDesigner Plus	599	397
Tiny Turbo 286	445	269
Paradise		
Autoswitch 480	349	179
VGA Plus	399	255
VGA Plus 16	499	295
VGA Professional	799	479
Practical Peripherals		
1200B Int Modem	99	60
2400B Int Modem	199	149
Prometheus		
Promodem 2400B	199	129
Promodem 2400G	249	149

	LIST	FAST
The Completa PC		
Answering Machine	349	209
Fax 4800	399	225
Hand Scanner 400	249	139
USRobotics		
1200 Baud Internal	149	89
1200 Baud External	179	89
2400 Baud Internal	249	119
2400 Baud Externel	279	149
Video 7		
Fast Write VGA	549	335
Vege Deluxa	379	Cell
Vega VGA	499	259
V-RAM VGA	799	469

LAPTOPS

Megahartz Modems		
2400B Toshiba	299	149
2400B NEC, Epson Mitsubishi or Zenith	399	199
Mitsubishi		
MP-286L Duel	3195	1879
MP-286L 20mb	4595	2449
NEC		
Multispeed EL II	2295	1449
Multispeed HD	3695	2249
Toshiba		
T1000	1249	759
T1000 768k Card	399	269
T1200F	2099	1369
T1200FB Backlit	2399	1499
T1200HB Backlit	3599	2399
T1600	4999	Call
T5100	7499	4495
Zenith		Cell

MONITORS

	LIST	FAST
Magnavox		
7BM749 VGA	229	149
9CM082 VGA	649	419
Mitaubishl		
1409 RGB	399	259
1410 EGA	599	339
Diemond Scan 1381	799	479
NEC		
Multisync 2e	799	Call
Multisync Plue	1399	869
Princeton		
Mex15	389	Cell
Ultrasync	849	479
Ultra 16	1375	859
Seiko CM1430	995	599
Sony		
1302 Multiscan	995	659
1303 Multiscan	825	449
Zenith 1490	999	599

DISK DRIVES

Miniscriba		
40MB AT #3650	499	319
Mitsubishi		
40MB AT MR535 22ms	825	399
Seagate		
20MB XT Kit #225	599	267
30MB XT Kit #238	699	287
40MB AT #251	899	349
40MB AT #251-1	999	449
80MB AT #4096	1199	549
Toshiba		
360K Floppy	119	89
720K 3.5" Floppy	149	79
1.2MB 5.25" Floppy	149	79
1.44MB 3.5" Floppy	189	99

Call On Non-Listed Items

SOFTWARE

Database

	LIST	FAST
Clipper	699	399
DataEase	600	389
dBase IV	795	439
dBXL Diamond	199	105
Foxbase Plus	395	185
Foxbase Plus Lan	595	295
Paradox 3.0	725	459
RapidFile	295	179
Rbase for DOS	700	Call
Reflex	150	90
Q & A	349	199
Q & A Lan Pack	299	185
Quicksilver	599	329

Desktop Publishing

Bylina	295	175
GEM Desktop Pub.	299	169
Pagemaker	795	Call
PFS:First Publisher	129	69
Publisher's Paintbrush	285	149
Ventura	895	489

Financial

Bedford Integr. Acct.	249	139
Computer Assoc. BPI		Call
DAC 3.0	99	59
DAC Peyroll 3.0	99	59
Dollars & Sense	179	99
Managing Your Money	199	117
Peachtree Complete II	199	149
Turbo Tax 1040	75	42

Graphics

	LIST	FAST
Deluxe Paint II	105	67
First Graphics	129	Cell
Freelance Plus	495	Cell
GEM Artline	495	269
GEM Draw Plus	299	165
Generic Cadd Level 3	250	149
Graph Plus	495	299
Harvard Graphics	495	Call
Perspective Jr.	149	85

Integrated

First Choice	159	89
Works	149	89
Windows 288	99	59
Windows 386	195	117

Mice

Kaytronics Serial or Bus	119	75
Logitech Serial or Bus	119	65
Logitech New HiRes	139	85
Microsoft Serial or Bus	150	95
Microsoft W/ Windows	200	129
OmniMouse Seriel	89	39
PC Mouse II Serial or Bus	149	82

Powar Protection

Curtis Ruby Plus	115	59
Datasheild 85	90	50
Datasheild 100	99	57

Programming

	LIST	FAST
Macro Assembler	150	89
Norton Guides (Specify)	100	58
Turbo Basic	99	60
Turbo C 2.0	149	90
Turbo Pascal 5.0	149	90
Quick Basic	99	60
Quick C	99	60

Spreadsheets

Allweye	150	82
Excal	495	Call
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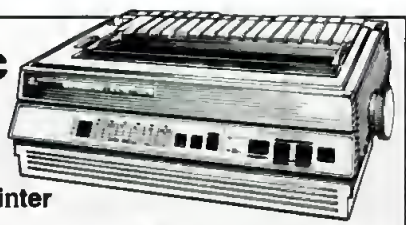

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PRODUCT CATEGORIES

HARDWARE

ADD-ON-BOARDS . . 443
CD-ROM 443
CABLES 443
COMMUNICATIONS 443, 444, 445
COMPUTER SYSTEMS 446, 447
DISK DRIVES 447
DISKETTES 448
EXPANSION UNITS 448, 465
PERIPHERALS 448, 449
POWER SUPPLIES 449
PRINTERS 449
SECURITY 449

SOFTWARE

ACCOUNTING 449, 450
BUSINESS 450
BUSINESS PROJECT MANAGEMENT 450
COMMUNICATIONS 450
CONSTRUCTION . . . 450
DATA BASE 450
DATA ENTRY 451
DESKTOP PUBLISHING 451
EDUCATION 451
ENGINEERING 451
ENTERTAINMENT/ GAMES 452
FINANCIAL . . . 452, 453
FLOWCHARTING 453
GRAPHICS 453, 454
HEALTH 454
INVENTORY 454
MAILING PROGRAMS 454
MANUFACTURING 454
MEDICAL 455
MUSIC 455
PREVENTATIVE MAINTENANCE . . . 455
PROGRAMMERS TOOLS 455, 456
PUBLIC DOMAIN . . 456, 457, 458
REAL ESTATE 458
RELIGION 458, 459
SALES MARKETING 459
SCIENTIFIC 459
SECURITY 459, 460
STATISTICS 460
SURVEYS 461
UTILITIES 461
WORD PROCESSING . . 461, 462

MISCELLANEOUS

ACCESSORIES 462
BAR CODING 462, 463
BOOKS/CATALOGUES/ PUBLICATIONS 463
COMPUTER INSURANCE 463
DATA CONVERSION 464
DATA RECOVERY SERVICES 464
DISK CONVERSION 464
DISKETTE COPY SERVICE 464
EXPANSION UNITS 465
NETWORKING 465
SUPPLIES 465

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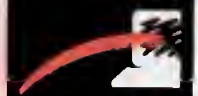

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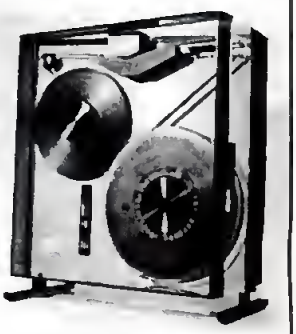

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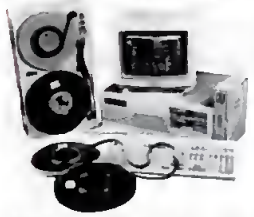

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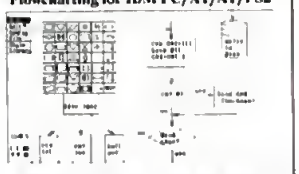

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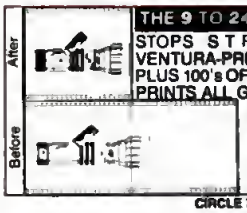

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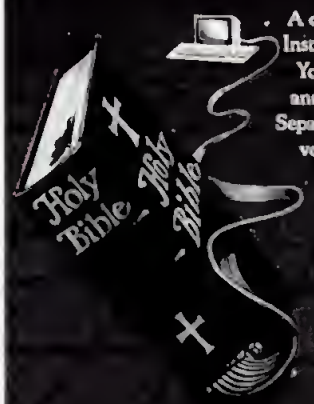

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EDITORIAL PRODUCT INDEX

READER SERVICE NUMBER	PRODUCT	COMPANY	PAGE
AFTER HOURS			
644	CompuServe Role-Playing Games	CompuServe	476
649	Create with Garfield, Deluxe Edition	DLM Teaching Resources	471
646	Fantavision	Broderbund Software Inc.	474
645	Fourth Portfolio Contest	The Source	474
647	Manhunter	Sierra On-Line Inc.	472
648	Paperboy	Mindscape Inc.	472
COMMUNICATIONS (MODEMS AND SOFTWARE)			
442	MET 2400X	Micro Electronic Technologies Inc.	52
COMPUTERS			
438	Compaq Deskpro 286e, Models 1, 20, and 40	Compaq Computer Corp.	52
450	Zenith Z-386/33	Zenith Data Systems	33
CONNECTIVITY			
440	EthernetXt	NetWorth Inc.	51
DESKTOP PUBLISHING			
443	Collage Plus	Inner Media	48
GRAPHICS (HARDWARE AND SOFTWARE)			
445	SLEd Image Processor	VS Software	46
437	Xerox Graph	Xerox Desktop Software Business Unit	52
HARDWARE			
441	MAXI RD45	Sysgen Inc.	52
439	PScomm2, PScomm4	Metacomp Inc.	51
LANGUAGES			
448	QuickC 2.0	Microsoft Corp.	36
SOFTWARE			
447	Actor, Version 1.2	The Whitewater Group Inc.	43
436	CAT Reader	Computer Aided Technology Inc.	51
448	Lucid 3-D, Version 2.0	Dac Software Inc.	33
444	PC-MIX	Proware	48
433	QuickTalk, Version 1.21	SilverSoft Inc.	54
446	VP Toolbox, Version 3.0	SNA Inc.	46
SPREADSHEET ANALYSIS			
435	@Stat, Version 1.0	Intex Solutions	54
TRAINING			
434	Advanced OS/2 Programming	Microsoft Press	54
WORD PROCESSING			
431	The Heavy Duty Word Processor for 1-2-3, Version 2.0	Bi-Intelligence Inc.	56
451	Volkswriter 4	Lifetree Software Inc.	38

PRODUCTIVITY

DEPARTMENT	PROGRAM NAME/DESCRIPTION	PAGE
PC Lab Notes	Optimize the performance of Microsoft Windows/386 and DESQview 386.	329
Utilities	Tell your printer exactly how to print a file without leaving your application.	345
Environments	An explanation of IBM's technical documentation for OS/2.	371
Power Programming	Learn how you can write programs that access memory above the normal DOS 1MB barrier.	377
Spreadsheet Clinic	Replace the value in a cell with a value calculated from it in 1-2-3.	391
Spreadsheet Clinic	Determine the median in a range of 1-2-3 values.	391
Spreadsheet Clinic	Password protection to blank your 1-2-3 screen from prying eyes.	392
User-to-User	Comparing the contents of two directories with COMP.	395
User-to-User	A simple deletion technique makes it easy to recover your files.	395
User-to-User	Make sure you don't delete the wrong file with this verify feature.	400
Power User	Use WordPerfect 5.0 macros to locate hard-to-find characters.	409
Power User	Underline and bold WordPerfect text in a single operation.	409
Power User	An easier way to find your style sheets in Word.	410
Power User	Tell your network printer to wait for a sheet of letterhead stationery.	411
Connectivity Clinic	A data switch can spoil protocol transfer attempts.	415
Connectivity Clinic	Not all software on a network is networked.	415
Connectivity Clinic	A free LAN Labs T-shirt offer!	416

COMING UP

DATABASES: OS/2 vs. DOS It's been more than 2 years since IBM introduced OS/2, heralding it as the operating system of tomorrow. Two years, and still DOS reigns supreme, with many software developers taking a wait-and-see attitude on Big Blue's "new standard." Many, but not all. Contributing editor Richard Hale Shaw reviews the OS/2 versions of *Paradox*, *Q&A*, and *R:BASE*—as well as their DOS counterparts—as *PC Magazine* examines this Tale of Two Operating Systems and determines whether OS/2 is indeed "a far, far better thing . . . ."

FORMS SOFTWARE It's a hot, new category of computer software, and it's rapidly growing—with more than a dozen vendors currently fighting it out for market share. But forms-generation programs, like the documents they produce, come in all shapes and sizes. *PC Magazine* evaluates 17 of these packages, examining the fine print and reading between the lines.

CLIP-ART LIBRARIES You want to complement your text with graphics but your artistic talent goes about as far as a stick figure with a hat. Or you just don't have the time it takes to sit down and create a dazzling illustration. Well, clip-art libraries are here, offering a wealth of predrawn artwork, all ready to use, all promising to add that professional touch to your newsletter, report, or business presentation. No desktop publisher will want to miss *PC Magazine*'s in-depth look at 13 of these popular packages.

FONTS With the number of typefaces available to LaserJet and PostScript printer owners rapidly approaching the number of printers out there—or seemingly so—choosing from among the hundreds of font products on the market can be a formidable task indeed. But fear not. Contributing editor Edward Mendelson comes to the rescue with a complete look at all the latest font cartridges, generators, editors, managers, utilities, and soft fonts. It's an article easily subtitled "Everything you need to know about fonts," and it's coming next issue.

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201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225 226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250
251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275 276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300
301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325 326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350
351 352 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374 375 376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400
401 402 403 404 405 406 407 408 409 410 411 412 413 414 415 416 417 418 419 420 421 422 423 424 425 426 427 428 429 430 431 432 433 434 435 436 437 438 439 440 441 442 443 444 445 446 447 448 449 450
451 452 453 454 455 456 457 458 459 460 461 462 463 464 465 466 467 468 469 470 471 472 473 474 475 476 477 478 479 480 481 482 483 484 485 486 487 488 489 490 491 492 493 494 495 496 497 498 499 500
501 502 503 504 505 506 507 508 509 510 511 512 513 514 515 516 517 518 519 520 521 522 523 524 525 526 527 528 529 530 531 532 533 534 535 536 537 538 539 540 541 542 543 544 545 546 547 548 549 550
551 552 553 554 555 556 557 558 559 560 561 562 563 564 565 566 567 568 569 570 571 572 573 574 575 576 577 578 579 580 581 582 583 584 585 586 587 588 589 590 591 592 593 594 595 596 597 598 599 600
601 602 603 604 605 606 607 608 609 610 611 612 613 614 615 616 617 618 619 620 621 622 623 624 625 626 627 628 629 630 631 632 633 634 635 636 637 638 639 640 641 642 643 644 645 646 647 648 649 650
651 652 653 654 655 656 657 658 659 660 661 662 663 664 665 666 667 668 669 670 671 672 673 674 675 676 677 678 679 680 681 682 683 684 685 686 687 688 689 690 691 692 693 694 695 696 697 698 699 700
701 702 703 704 705 706 707 708 709 710 711 712 713 714 715 716 717 718 719 720 721 722 723 724 725 726 727 728 729 730 731 732 733 734 735 736 737 738 739 740 741 742 743 744 745 746 747 748 749 750
751 752 753 754 755 756 757 758 759 760 761 762 763 764 765 766 767 768 769 770 771 772 773 774 775 776 777 778 779 780 781 782 783 784 785 786 787 788 789 790 791 792 793 794 795 796 797 798 799 800
801 802 803 804 805 806 807 808 809 810 811 812 813 814 815 816 817 818 819 820 821 822 823 824 825 826 827 828 829 830 831 832 833 834 835 836 837 838 839 840 841 842 843 844 845 846 847 848 849 850
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451 452 453 454 455 456 457 458 459 460 461 462 463 464 465 466 467 468 469 470 471 472 473 474 475 476 477 478 479 480 481 482 483 484 485 486 487 488 489 490 491 492 493 494 495 496 497 498 499 500
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551 552 553 554 555 556 557 558 559 560 561 562 563 564 565 566 567 568 569 570 571 572 573 574 575 576 577 578 579 580 581 582 583 584 585 586 587 588 589 590 591 592 593 594 595 596 597 598 599 600
601 602 603 604 605 606 607 608 609 610 611 612 613 614 615 616 617 618 619 620 621 622 623 624 625 626 627 628 629 630 631 632 633 634 635 636 637 638 639 640 641 642 643 644 645 646 647 648 649 650
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701 702 703 704 705 706 707 708 709 710 711 712 713 714 715 716 717 718 719 720 721 722 723 724 725 726 727 728 729 730 731 732 733 734 735 736 737 738 739 740 741 742 743 744 745 746 747 748 749 750
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801 802 803 804 805 806 807 808 809 810 811 812 813 814 815 816 817 818 819 820 821 822 823 824 825 826 827 828 829 830 831 832 833 834 835 836 837 838 839 840 841 842 843 844 845 846 847 848 849 850
851 852 853 854 855 856 857 858 859 860 861 862 863 864 865 866 867 868 869 870 871 872 873 874 875 876 877 878 879 880 881 882 883 884 885 886 887 888 889 890 891 892 893 894 895 896 897 898 899 900

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INDEX TO ADVERTISERS

RS #	ADVERTISERS	PAGE
234	3X USA	58
218	Achieve Micro Systems	237
185	Advanced Logic Research	163
241	Advanced Logic Research	165
251	Advanced Logic Research	167
493	Advanced Logic Research	169
348	Aldus Corporation	120-121
168	Alloy Computer Products	301
242	Alps America	194-195
279	Altec Technology	366
335	American Mitac	223
475	American Small Business	252
232	American Technology Labs	372
*	Anthro Corporation	78
142	Applause Software	62
477	Applied Creative Technology	63
111	Arche Technologies	152
336	Arlington Computer Products	420-421
519	Ashton Tate	298-286
166	AST Research	283
124	Attachmate	413
509	Austin Computers	10-11
356	BASF Corp	226
116	Blaise Computing	384
140	Bloc Publishing	88
137	Borland International	57
377	Borland International	55
128	Brightbill Roberts & Co	417
481	Bulldog Computer Products	69-61
180	Bureau of Electronic Publishing	16
355	Business To Business	448
494	Buttonware	412
292	Caere Corporation	288
144	Calera Recognition Systems	309
314	California Freeware	410
*	Central Point Software	72
252	Clone Computers	433
188	Command Technology Corp	321
*	Compaq Computer Corporation	226-227
135	Complete PC	39
328	CompuAdd	215-219
205	Compuclassics	53
274	Computability	437
176	Computer Aided Management	281
739	Computer Aided Technology Inc	324
317	Computer Associates	325
102	Computer Associates	178-179
109	Computer Discount Warehouse	439
183	Computer Mail Order	366-367
178	Computer Oasis	426
163	Computer Products United	50
538	Cordata	382
198	Core International	243
379	Corel Systems	411
194	Cougar Mountain Software	332
278	Crosstalk/DCA	76
383	Cuesta Systems Corp	232
*	Curtis Manufacturers	101
*	Dac Software	67
*	Dac Software	70
484	Datamedia	119
504	Datastorm Technologies	192
*	Dataworld	292-293
392	Datran	403
536	Dell Computer Products	C5-C8
*	Dell Computer Products	477-478
256	Delta Technology	324
742	Diamond Flower Electric Instruments	461
324	Diversified Technologies	78
217	Dual Group	394
330	Dynamic Microprocessor Assoc	405
363	Eastman Kodak	172-173
528	Electronic Wholesale House	433
208	Empirse Game Systems	479
187	Enable Software Inc	169
*	Epson America	312-314
216	Everex Systems, Inc	234-235
152	Express Micro Mart Inc	426-427
352	FASTMICRO	436
286	Fifth Generation	261
288	Fifth Generation	145
174	Formworx Corp	226
*	Forte Communications, Inc	167
112	Fox Software	64
503	Fujitsu America, Inc	184-185
364	Gateway 2000	88-89
737	General Computer Stores	426
506	Generic Software	383
266	GenTech	211
369	Golden Bow Systems	4
537	Golden Eagle Micro	433
351	Hard Drives International	374
201	Haventree Software	366
277	Hawk Computers	492
136	Hayes Microcomputer Products	326
491	Hewlett Packard Peripheral Group	270-271
328	Hyperwara	300
*	IBM Corp	336-336
218	IGC	90
257	Indigo Software LTD	499
244	Information Builders	393
517	Intel	264-264
512	Intel	375
195	Intelligence Technology Corp	32
285	Intergraph Corporation	373
*	Intuit Software	47
378	Iomega Corporation	12-13
325	ID Engineering	44
219	Irwin Magnetics	124
243	Jade Computer Products	441
346	Jameco	422
533	Kensington Microware Ltd	82
214	Key Tronic	390
525	Lahey Computer Systems	228
*	Laptops Plus	418
280	LaserGo, Inc	267
197	LaserTools	316
182	Logitech	326-327
*	Lotus	74-75
*	Lotus	137
263	Macola, Inc	348-349
726	Mannesman Tally	326
197	Manzana Microsystems Inc	388
154	MathSoft	176
495	Maynard Electronics	246
298	MCI, International	261
332	Meca	176
387	MHI Warehouse	436
*	Micro Warehouse	199-200
*	MICRDBEST	435
*	Micrografx	20
*	Microsoft	1
*	Microsoft	C2-C4
*	Microsoft	317
*	Microsoft	408
331	Microway	355
489	Midwest Computer Works	424
527	Mika, L P	154
368	Mitsubishi Electronics	366-361
514	Monolithic Systems	66
178	Mullisoft Corporation	396
373	Mutoh America	311
344	National Computer Ribbons	432
733	Natural Microsystems	319
526	NCR Corporation	389-381
153	NEC Home Electronics Inc	90-81
258	NEC Home Electronics Inc	2-3
*	NEC Information Systems	93
177	Newer Technology	84
*	Northgate Computer Systems	342-343
*	Northgate Computer Systems	205-207
*	Northgate Computer Systems	385-387
*	Northgate Computer Systems	335
*	Northgate Computer Systems	231
*	Northgate Computer Systems	367
235	Okidata	213
498	Olivetti	407
*	Oracle	9
*	Oracle	14
476	Output Technology	221
*	Panasonic	129-132
359	Paradise/Western Digital Imaging	107
360	Paradise/Western Digital Imaging	109
362	Paradise/Western Digital Imaging	111
357	Paradise/Western Digital Imaging	113
236	Paul Mace Software	94
303/308	PC Brand	156-157
309/304	PC Brand	158-159
310/311	PC Brand	160-161
*	PC Connection	254-259
301	PC Exchange	475
245	PC Link	191
497	PC Magnet	496
358	Peachtree Software	233
313	Performance Technology	290
302	Peter Norton Computing	350
*	Plus Development	149-151
203	Primetime Software	292
*	Quaid Software	372
391	Quanta Prese, Inc	239
192	Quantum Software	395
290	Rose Electronics	376
295	RP Systems	423
131	Samna	26
150	Samtron	388
*	Seagate	134
211	Sefco	341
184	Shamrock	434
389	Sigma Designs	396-307
478	Softklone	239
*	Softline	18-19
334	Softlogic Solutions	28
725	Softlogic Solutions	123
724	Softlogic Solutions	48
138	Softshell Systems	114
186	Software Directions	45
393	Software Link, The	287
*	Software Publishing	251
161	Storage Dimensions	116
366	Sun Microsystems	103-105
299	SWFTE International	37
249	Symantec Corp	26
173	Sysgen Inc	224
240	Systems Compatibility	21
209/201	Tandy Corp	193
255	Tandy Corp	367
384	Tecmar Inc	128
749	Telebit	76
206	Telemart	66-67
123	Telemart	88-89
259	The Laser Connection	5
747	TLB Inc	288
*	TOPS	263
321	Toshiba of America	276-277
223	Traveling Software	344
121	Tri-Star Computer	143
735	Triton Technologies	362
268	Tussey Computer Products	22-25
729	TwinCom	38-31
387	Universal Data	414
296	Unisys Corp	146-147
230	US Sage	366
105	USA Flex	429-431
260	Verbatim	42
390	VNS America Corp	186
139	VNS America Corp	425
171	Warehouse Data Products	358-359
515	Wells American	17
189	Western Telematic	404
518	Xyquest	244
721	Zeos	398-399
*	Zeos	245
723	Zeos	246-247

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AFTER HOURS

EDUCATION

Garfield the Cat Stars in Cartoon Generator for Kids

BY ALAN COHEN

Well, he's had his own television special and his own American Express commercial, so it was only a matter of time before someone designed a computer program around Garfield, the world's most famous Fat Cat.

Create with Garfield, Deluxe Edition, $39.95 from DLM Teaching Resources, lets children design and print their own comics, cartoons, posters, and labels. These creations all feature You-Know-Who himself. The program is set up so that even children with absolutely no artistic talent can easily and quickly compose professional-looking artwork.

Your child begins by selecting a background from among a variety of predrawn scenes. To this beginning, picture elements, or *stick-ons*, can be added and arranged.

Besides a wealth of Garfield poses, there are stick-on representations of all our hero's favorite and perhaps not so favorite animated pals. Captions are easily added to the picture once the artwork is in place. The child either chooses from among the prewritten captions or composes original dialogue.

Create with Garfield is a lot of fun, but it isn't without its problems. The four-color CGA graphics are far from stunning. And once a stick-on is "stuck on" to a scene, erasing it becomes a production in itself.

If you're willing to deal with these inconveniences (or, perhaps more appropriately, willing to let your child deal with them), you'll find *Create with Garfield* to be a worthwhile program that's stimulating to young minds. PC

Your child can make Garfield say whatever his or her heart desires with Create with Garfield, Deluxe Edition. *Artistic talent is not required.*

List Price: *Create with Garfield, Deluxe Edition*, $39.95. **Requires:** 256K RAM, CGA graphics, DOS 2.1 or later. Copy protected. DLM Teaching Resources, One DLM Park, Allen, TX 75002; (800) 527-4747, (800) 442-4711 (in Tex.).

CIRCLE 649 ON READER SERVICE CARD

YOU'VE READ ABOUT IT, NOW PLAY IT!

XENOPHOBE, the Play-By-Mail game given mention in an article in this issue's After Hours section. If you want to become a starship captain, engage in diplomacy, make your ship larger and faster, vaporize other ships or anything else that comes to mind you have five, count 'em, five ways to get FREE information from us:

1) Call us any day at 619-744-LOOK from noon until midnight to speak to us face-to-face.
2) Call us any day at 619-744-LOOK from midnight until noon to use our BBS system.
3) Contact us on CompuServe by leaving your name and address for us using our account number: 76670,1657.
4) Circle the number listed below on the reader response card.
5) Write us at our office at:

Emprise Game Systems
Dept. PCM
P.O. Box 83
San Marcos, CA 92069

If you do any of these things we will send you information on all of our games. Or, you can speed up your entry into **XENOPHOBE** by sending us a check or money order for $9.95 for your copy of the **XENOPHOBE** rules package. This includes 80 pages of rules, maps, charts, tables and so forth.

(Also, ask how you can play a FREE Sampler of our other game, **WARP FORCE EMPIRES**! Plus, don't forget to ask for information on our upcoming game **WORLD CAMPAIGNS**!)

CIRCLE 208 ON READER SERVICE CARD

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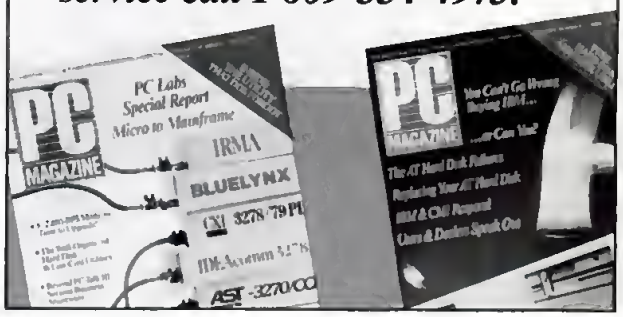


PC MAGAZINE ADVERTISERS PRODUCT INDEX

RS#	ADVERTISER	PRODUCT	PAGE#
ACCOUNTING SOFTWARE			
317	Computer Associates	ACC Pac	325
194	Cougar MT Software	ACT 2 Accounting Software	332
*	DAC Software	DAC Easy Accounting	70
263	Macola Inc	Accounting Software	348-349
301	PC Exchange	Accounting Software	475
358	Peachtree Software	Double Bonus Bundle	233
747	TLB, Inc	"Profitwise"	288
DATABASE MANAGERS			
519	Ashton Tate	Framework-Software	298-299
377	Borland International	Paradox 3.0	55
494	Buttonware	PC File dB	412
112	Fox Software Inc	MAC Database	64
244	Information Builders	D-Base Management Software	393
*	Oracle	Database Management Software	9
*	Oracle	Database Management Software	14
249	Symantec	Q & A	26
FILE SYSTEMS & ACCESS METHODS			
*	QAC Software	Rolodex	70
FINANCIAL PLANNING SOFTWARE			
*	Intuit Software	Quicken	47
332	Meca	Checkwrite Plus	175
INFORMATION MANAGERS			
283	Primetime Software	Personal Information Manager	202
INTEGRATED SOFTWARE			
187	Enable Software Inc	Enable	189
*	Microsoft	Works	317
LANGUAGES			
525	Lahey Computer Systems	Language	228
280	Lasergo Inc	Go Script	297
OPERATING SYSTEMS/ENVIRONMENTS			
192	Quantum Software System, Inc	QNX	305
725	Softlogic Solutions	Software Carousel	123
393	Software Link, Inc	PC-MOS/386 OP Sys	287
PROJECT MANAGEMENT			
176	Computer Aided Management	View Point	281
201	Haventree Software	Project Management Software	369
STATISTICAL SOFTWARE			
154	Mathsoft Inc	Math CAD	176
TEXT EDITORS			
188	Command Technology Corp	SPF/PC	321
UTILITIES			
*	Central Point Software	PC Tools Deluxe	72
392	Datran	Disk Doubler	403
256	Delta Technology	Direct Net/Direct Access	324
369	Golden Bow Systems	V-Opt	4
280	Lasergo Inc	Go Script	297
*	Lotus	Magellan	74-75
170	Multisoft Corporation	PC Kwik	396
236	Paul Mace Software	Mace Utilities	94
302	Peter Norton Computing	Utilities	350
*	Quaid Software LTD	Copywrite	372
290	Rose Electronics	Master Link	376
334	Softlogic Solutions	@ Liberty	28
724	Softlogic Solutions	Fatcat	49
725	Softlogic Solutions	Software Carousel	123
138	Softshell Systems	DOS Shell	114
223	Traveling Software	ViewLink	344
WORD PROCESSING SOFTWARE/AIDS			
142	Applause Software	Perfect Addition	92
325	IQ Engineering	Super Cartridge 1	44
325	IQ Engineering	Super Cartridge 1 Enhanced	44
265	LaserGo Inc	Go Script	373
131	Samna	Word Processing Software	29
*	Software Publishing	Pro Write	251
240	Systems Compatibility Corp	Wordprocessor Conversion S/W	21
518	XYQuest	XY Write III Plus	244
CAD/CAM			
475	American Small Business Comp	Design CAD 3-D	252
506	Generic Software Inc	Generic CADD	363
265	Intergraph Corporation	Microstation	373
SPREADSHEET/TEMPLATES			
137	Borland International	Quattro	57
317	Computer Associates	Super Calc	325
*	DAC Software	Lucid 3-Q	67
*	DAC Software	Lucid 3-D	70
*	Microsoft	Excel	C2-1
334	Softlogic Solutions	@ Liberty	28
DESK TOP PUBLISHING			
348	Aldus Corporation	Pagemaker	120-121
325	IQ Engineering	Super Cartridge 1	44
325	IQ Engineering	Super Cartridge 1 Enhanced	44
280	Lasergo Inc.	Go Script	297
182	Logitech	Finness	326-327
299	SWFTE International, Ltd	Glyphix	37

RS#	ADVERTISER	PRODUCT	PAGE#
DATA ENTRY SOFTWARE			
174	Formworx Corp	Data Entry Software	228
ENTERTAINMENT SOFTWARE			
208	Emprise Game Systems	Mail In Games On Compuserve	470
FORM DESIGNERS			
140	Bloc Development	Form Designers	66
174	Formworx Corp.	Formworx	228
257	Indigo Software LTD	Electronic Forms, Jet Forms	400
SHAREWARE SOFTWARE			
391	Quanta Press, Inc.	Shareware Software	230
COMPATIBLE KEYBOARDS			
165	Advanced Logic Research	PC's	163
241	Advanced Logic Research	PC's	165
251	Advanced Logic Research	PC's	167
493	Advanced Logic Research	PC's	169
163	Computer Products United	PC's	50
121	Tri-Star Computer	Systems	143
515	Wells American	CompuStar	17
BACKUP SOFTWARE			
288	Fifth Generation	Fastback Plus	291
729	Twincom, Holland	Hard Disk Back-Up Software	30-31
DISK BACKUP & TAPE DRIVES			
370	Corel Systems	Optical Disk Drive	411
219	Irwin Magnetics	Tape Back-Up	124
197	Manzana Microsystems	External Disk Drives	388
495	Maynard Electronics	Tape Back Up	249
288	Swan Technonogies/TCP	Tape Back-Ups	22-25
173	Sysgen Inc	Bridge File	224
384	Tecmar Inc	Tape Back Up	126
HARD DISKS			
232	American Technology Labs	Hard Disk And Accessones	372
392	Datran	Disk Doubler	403
351	Hard Drives International	Hard Drives	374
378	Iomega Corporation	Bernoulli Box	12-13
*	Lotus	Magellan	74-75
*	Plus Development	Plus Passport	149-151
*	Seagate	Hard Disk Drives	134
161	Storage Dimensions/Maxtor	Laser Stor	116
COMPUTERS/COMPATIBLES			
218	Achieve Communications	PC's	237
270	Altec Technology Corp.	PC Compatibles	365
335	American Mitac	MPC 4000 386	223
111	Arche Technologies	Arche Rival	152
166	AST Research	Computer Systems	203
509	Austin Computers	Compatibles	10-11
481	Bull Dog Computer Products	Computer/Accessones	60-61
252	Clone Computers	Compatibles	433
*	Compaq Computer Corporation	Compatibles	226-227
538	Cordata	CS 5000	302
484	Data Media	NETmate	119
*	Dataworld	Systems/PC's	292-293
536	Dell Computer Corporation	Dell Computers	C5-C8
324	Diversified Technologies	386 PC	78
*	Epson	Compatible	312-314
216	Everex Systems, Inc	Step Computers	234-235
737	General Computer Stores	Mail Order	428
*	IBM Corp	PS2 Compatible	338-339
210	IGC	VM/386	90
368	Mitsubishi Electronics	Computer Systems	360-361
528	NCR Corporation	Computers	360-361
258	NEC Home Electronics Inc	386 Machine	2-3
*	NEC Information Systems	Power Mate Personal Computers	93
*	Northgate Computer Systems	286/12	385-387
*	Northgate Computer Systems	"3 Choice"	342-343
*	Northgate Computer Systems	"Elegance"	205-207
303/308	PC Brand	Computers/Compatibles	156-157
309/304	PC Brand	Computers/Compatibles	158-159
310/311	PC Brand	Computers/Compatibles	160-161
245	PC Link	Computers/PC's IBM Compatibles	191
366	Sun Microsystems	386i	103-105
288	Swan Technologies/TCP	Compatibles	22-25
255	Tandy Corporation	Compatibles	397
296	Unisys Corp	386 Work Groups	146-147
515	Wells American	CompuStar	17
388/723	Zeos International	386'S	245-247
721	Zeos International	Computers Now	398-399
INPUT DEVICES			
292	Caere Corporation	Omnipage	208
144	Calera Recognition Systems	True Scan	309
742	Diamond Flower Electric Instruments	Hand Scanner	401
214	Key Tronic	Mouse	390
*	Microsoft	Mouse	408
*	Northgate Computer Systems	Keyboards	335
PROGRAMMERS TOOLS UTILITIES			
116	Blaise Computing	Programming Tools	384
331	Microway	Programmers Tools & Utilities	355
ADD-ON BOARDS			
135	Complete PC	The Complete Fax/9600	39

continued

AFTER HOURS

GAMES

Manhunter: A Grisly Vision of New York Under Alien Control

BY STEPHANIE K. LOSEE

The beautiful opening screens of *Manhunter*, Sierra On-Line's latest graphics-based adventure game, set you up for something really good. While the game boasts some of the best graphics you've ever seen, actually playing it turns out to be a massive anticlimax.

In Manhunter, *Coney Island is but one of the New York landmarks you'll visit in your efforts to banish the oppressive Orbs from Earth.*

It is 2004. Two years earlier, the sadistic "Orbs" invaded New York City, bringing life as it was known to a halt and designating certain humans as "Manhunters." These unfortunates must track down and report the names of fellow humans who have committed crimes against the Orb Alliance.

The premise is certainly compelling, but game play is for the most part rudimentary. If there's anything of interest in a given scene, the cursor alerts you to its presence when you scroll over it. This eliminates the frustration that comes from searching, but it makes each step far too obvious. Often you'll walk into a dazzling scene to find that there's only one thing to pick up or look at, and the rest is just a pretty picture. But it's not all pretty—this game is full of graphic violence. You'll watch your limbs blown off, your head smashed to a pulp, and the skin removed from your face.

Amid the blood and gore, *Manhunter* does have merit, including the superb graphics. The game takes place in an architecturally correct rendition of New York, with accurate maps of the city and faithfully represented interiors and exteriors of existing buildings. Along the way you'll encounter several arcade-style games and obstacles that provide a welcome challenge.

Like *Space Quest*, Sierra On-Line's superior cousin to *Manhunter*, the game concludes with a tag line about the upcoming episode in what turns out to be an ongoing series. If you're new to this kind of graphics-based adventure game, you may find *Manhunter* an ideal introduction, since it isn't nearly as challenging as some others. But be forewarned: a strong stomach is a prerequisite.

List Price: *Manhunter*, $49.95; Hint Book, $7.95. **Requires:** 256K RAM; CGA, EGA, MCGA, VGA, or Hercules graphics; DOS 2.0 or later. Copy protected through documentation. Sierra On-Line Inc., P.O. Box 485, Coarsegold, CA 93614; (209) 683-4468.

CIRCLE **647** ON READER SERVICE CARD

GAMES

Paperboy Takes You on The Route to Mischief

BY PHILIP F. H. ROSE

Are you worn out from racing along mountain roads in *Test Drive* and performing aerial acrobatics in *Advanced Flight Simulator*? Bored with outsmarting wizards and battling dragons? How about a career in newspaper delivery to relieve the stress of life? *Paperboy*, Atari's much-loved arcade classic, is now available for the PC from Mindscape at $39.95.

The rules are simple. You have newspapers to deliver. There are houses on a street to deliver them to. Of course, there are a few snags along the way. Besides cars and pedestrians, you will encounter barking dogs, rolling hubcaps, and a hostile lawn mower that wants to cut more than the grass.

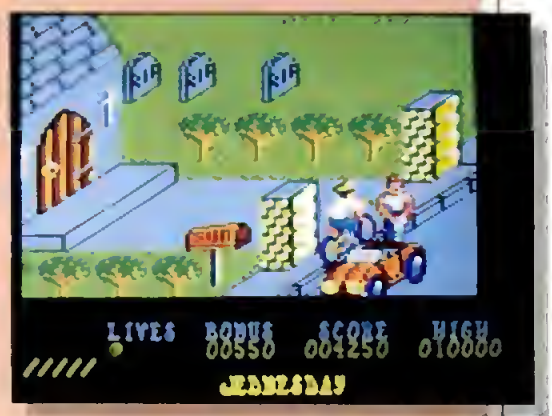
As you weave your way through these obstacles, you must try to deliver your newspapers to the correct houses, indicated by the word "subscriber" flashing in the bottom right corner of the screen. In the true spirit of the seedy video arcade, *Paperboy* sometimes rewards downright sleazy behavior. You get bonus points for "accidentally" breaking the windows of nonsubscribers by throwing newspapers through them. The whole idea is to balance the use of your newspapers between real subscribers and these targets while you head for the next newspaper pickup.

Once you finish the day's deliveries, you get to knock off some more targets for bonus points as you stunt cycle along a dirt field. Your day's record is then tallied. Each subscriber whom you failed to deliver a newspaper to drops his subscription. If you lose too many subscribers, your boss may fire you—it's a dog-eat-dog world out there. But if you have done a good job and delivered to all of your subscribers, you pick up additional houses on your route. Each day, the number of obstacles you face increases, and the pace of the action picks up.

While the excitement level may never reach that of PC shoot-em-ups, *Paperboy* offers a nice change of pace. Game manufacturers should continue to look deep into the recesses of the arcade game past. They might find many other games worthy of revival on PCs.

List Price: *Paperboy*, 39.95 **Requires:** 256K RAM, CGA or EGA, DOS 2.0 or later. Copy protected. Mindscape Inc., 3444 Dundee Rd., Northbrook, IL 60062; (312) 480-7667.

CIRCLE **648** ON READER SERVICE CARD



In Paperboy *you must not fail to deliver the paper to a subscriber's house, no matter what obstacles block your way*

RS#	ADVERTISER	PRODUCT	PAGE#
*	OAC Software	Breakthrough 286	70
517	Intel	Math Co-Processor	284-285
512	Intel	Connection Co-Processor	375
325	IO Engineering	Super Cartridge 1	44
325	IO Engineering	Super Cartridge 1 Enhanced	44
197	Manzana Microsystems	External Disk Drives	388
514	Monolithic Systems	Just Ram Microframe, Connect	85
177	Newer Technology	Addition/Attraction	84
211	SEFCO	Add-On Board	341
268	Swan Technologies/TCP	VGA Boards	22-25

SCANNERS/DIGITIZERS

292	Caere Corporation	Omnipage	208
144	Calera Recognition Systems	True Scan	309
739	Computer Aided Technology	Optical Character Recognition	324
363	Kodak	OIC - Diconix 150 Printer	172-173

PRINTERS

242	Alps America	Laser Printers	194-195
503	Fujitsu America Inc	Laser Printers	184-185
491	Hewlett Packard-Peripheral Group	Desk Jet	270-271
325	IO Engineering	Super Cartridge 1	44
325	IO Engineering	Super Cartridge 1 Enhanced	44
260	LaserGo Inc	Go Script	297
726	Mannesman Tally	MT 905 Laser Printer	328
476	OutputTechnology	560 DL Printer	221
*	Panasonic Computer Division	1100 Series Printers	129-132
	Western Telematic	Printer Sharing Device	

PRINTER RIBBONS

344	National Computer Ribbons	Computer Ribbons	432

PRINTER ACCESSORIES

477	Applied Creative Technology, Inc	Optimizer Plus	63
217	Dual Group	Printer Accessories	394
268	Fifth Generation	Logical Connection	145
328	Hyperware	Buffalo SL	300
325	IQ Engineering	Super Cartridge 1	44
325	IO Engineering	Super Cartridge 1 Enhanced	44
107	Lasertools Corp	Laser Torq	318
290	Rose Electronics	Master Switch, Master Net, Master Link	376
189	Western Telematic	Printer Sharing Device	404

PORTABLE/LAP COMPUTERS

195	Intelligence Technology Corp	Portable Cellular Laptop	32
*	Laptops Plus	Laptops	419
321	Toshiba of America	Laptops	276-277

OPTICAL PERIPHERALS

180	Bureau of Electronic Publishing	CD ROM	16

MEMORY SUBSYSTEMS

197	Manzana Microsystems	External Disk Drives	388

DISPLAYS/MONITORS/TERMINALS

150	Samtron	Monitor	389
389	Sigma Designs	Laserview	306-307

GRAPHICS SOFTWARE

174	Formworx Corp	Graphics Software	228
*	Lotus	Graph Writer	137
*	Micrografx	Designer/Graph Plus	20

PLOTTERS/CHARTING DEVICES

373	Mutoh America Inc	Plotters	311

VIDEO GRAPHICS/BOARDS

359	Western Digital Imaging/Paradise	VGA Boards	107
360	Western Digital Imaging/Paradise	VGA Boards	109
362	Western Digital Imaging/Paradise	VGA Boards	111
359	Western Digital Imaging/Paradise	VGA Boards	113

ACCELERATOR BOARDS

277	Hawk Computers	386 Motherboards	402
331	Microway	Accelerator Boards	355

COMMUNICATIONS SOFTWARE

234	3X USA	3X-Link 16	58
198	Core International	Communications Software	243
278	Crosstalk Communications	Remote 2	76
504	Data Storm Technologies Inc	Pro Comm	192
330	Dynamic Microprocessor Assoc	P C Anywhere	405
136	Hayes Microcomputer Products	Smartcom 3 Communications S/W	320
527	Mika, L P	Whisper	154
290	Rose Electronics	Master Net	376
478	Softklone	Mirror III	239
735	Triton Technologies	Co/Session	382

LOCAL AREA NETWORKING

168	Alloy Computer Products	386/Multiware	301
477	Applied Creative Technology, Inc.	Optimizer Plus	63
278	Crosstalk Communications	Remote 2	76
288	Fifth Generation	Logical Connection	145
313	Performance Technology	Power LAN	290
290	Rose Electronics	Master Switch, Master Net	376
*	TOPS	TOPS Connectivity	283
230	US Sage	Main Lan	368

MICRO-MAINFRAME LINKS

124	Attachmate	NOW! PC/Host Autoware	413

MODEMS

733	Natural Microsystems	Watson	319
235	Okidata	Modems	213
740	Telebit	Modem	79
367	Universal Data Systems	Modems	414

DISKETTES

356	BASF Corp	5 25" Diskette	229
260	Verbatim	Diskettes	42

FURNITURE

*	Anthro Corporation	Furniture	78

POWER PROTECTION

232	American Power Labs	Hard Disks And Accessories	372
383	Cuesta Systems Corp	Data Saver	232
533	Kensington Microware LTD.	Masterpiece Remote	82

SECURITY

186	Software Directions	Software Securities Program	44

PC ACCESSORIES

232	American Technology Labs	Hard Disk And Accessories	372
*	Curtis Manufacturing	PC Accessories	101

MAIL ORDER

336	Arlington Computer Products	Mail Order	420-421
509	Austin Computers	Mail Order	10-11
481	Bull Dog Computer Products	Computer/Accessories	60-61
355	Business To Business	Mail Order	440
314	California Freeware	Shareware/Public Domain S/W	410
252	Clone Computers	Mail Order	433
320	Compu Add	Mail Order	215-219
205	Compuclassics	Mail Order	53
274	Computability	Mail Order	437
109	Computer Discount Warehouse	Mail Order	439
183	Computer Mailorder	Mail Order	366-367
176	Computer Oasis	Mail Order Products	428
520	Electronic Wholesale House	Mail Order	433
152	Express Micro Mart, Inc	Mail Order	426-427
352	FastMicro	Mail Order	436
364	Gateway 2000	Mail Order	68-69
737	General Computer Stores	Mail Order	428
266	Gentech	Mail Order	211
537	Golden Eagle Micro	Mail Order	433
351	Hard Drives International	Hard Drives	374
243	Jade Computer Products	Mail Order	441
346	Jameco Electronics	Mail Order	422
*	Laptops Plus	Mail Order	419
298	MHI Warehouse, Inc	Mail Order	261
*	Micro Warehouse	Mail Order	199-200
*	MICROBEST	Mail Order	435
489	Midwest Computer Works	Mail Order	424
344	National Computer Ribbons	Computer Ribbons	432
303/308	PC Brand	Mail Order	156-157
309/304	PC Brand	Mail Order	158-159
310/311	PC Brand	Mail Order	160-161
*	PC Connection	Mail Order	254-259
301	PC Exchange	Mail Order	475
295	RP Systems	Mail Order	423
184	Shamrock	Mail Order	434
*	Softline	Mail Order	18-19
205	Telemart	Mail Order	86-87
123	Telemart	Mail Order	88-89
268	Tussey Computer Products	Mail Order	22-25
105	USA Flex	Mail Order	429-431
186	VNS America Corp	Mail Order	390
171	Warehouse Data Products	Mail Order	358-359

ON LINE DATABASES

208	Emprise Game Systems	Mail In Games On Compuserve	470
298	MCI, International	E Mail	261
497	PC Magnet	On Line Database	406
291/289	Tandy Corporation	PC Link	193

ELECTRONIC MAIL

208	Emprise Game Systems	Mail In Games On Compuserve	470

ORGANIZATIONS/SERVICES

*	Northgate Computer Systems	Sorbus	357

MISCELLANEOUS

*	Forte Communications Inc	Remote Keyboard	187

DIRECT MARKETING CONNECTION

336	Arlington Computer Products	Mail Order	420-421
355	Business To Business	Mail Order	440
252	Clone Computers	Mail Order	433
274	Computability	Mail Order	437
109	Computer Discount Warehouse	Mail Order	439
176	Computer Oasis	Mail Order	428
520	Electronic Wholesale House	Mail Order	433
152	Express Micro Mart, Inc	Mail Order	426-427
352	Fastmicro	Mail Order	436
737	General Computer Stores	Mail Order	428
537	Golden Eagle Micro	Mail Order	433
243	Jade Computer Products	Mail Order	441
346	Jameco Electronics	Mail Order	422
*	Laptops Plus	Mail Order	419
387	MHI Warehouse, Inc	Mail Order	438
*	Microbest	Mail Order	435
489	Midwest Computer Works	Mail Order	424
344	National Computer Ribbons	Mail Order	432
295	RP Systems	Mail Order	423
184	Shamrock	Mail Order	434
105	USA Flex	Mail Order	429-431
186	VNS America Corp	Mail Order	390

AFTER HOURS

ON-LINE SERVICES

Portfolio Contest Tests Investment Skills, Without the Usual Risk

BY DONALD B. TRIVETTE

If you've always suspected that—given some cash—you could be another T. Boone Pickens, now's your chance. On June 1, The Source begins its fourth Portfolio Contest.

You start with $100,000 to invest in securities. When the game ends on July 31, the folks at The Source will evaluate your portfolio. If your gains exceed those of the other contestants, you win $1,000. And this thousand—unlike the $100,000—is real, spendable money.

A stockbroker won the first Portfolio Contest by turning $100,000 into $350,000. An engineer (who *must* be considering a career change) picked up the $1,000 in the second contest. Currently, the third contest is in progress.

As I write this, I'm heavily invested in options. With some extraordinary good luck, my portfolio will be at the top of the heap on March 31. In the meantime I've lost $80,000, but it's not as devastating as it seems. The Source lets you create as many $100,000 portfolios as you want, so I've got several that are more conservative.

The Source offers some services to help you select your investments, whether they are part of the game or for real. Investext reports financial data and projections for major companies; Stockvue summarizes more than 4,300 stocks; and Vestor makes weekly recommendations and predictions.

The Portfolio Manager—the same one you'll use in the contest—is one of The Source's most powerful investment tools. It allows you to sort, print, and analyze your portfolios in a variety of ways, including gains and losses by period and holdings by tax lot.

The Source has agreed to pick up part of the tab for the fourth contest for *PC Magazine* readers. When you call to open an account, give the claim number 7800T58, and The Source will waive its $30 initiation fee and give you a $15 credit. Who knows, maybe you'll win the fourth contest; I've got the third one sewn (loosely) up.

List Price: Fourth Portfolio Contest. Standard Source connect charges apply, based on time of day and bit-per-second rate. **Requires:** Modem, communications software. The Source, 1616 Anderson Rd., McLean, VA 22102; (800) 336-3366.

CIRCLE **645** ON READER SERVICE CARD

The Source's Fourth Portfolio Contest has facilities that allow you to track the progress (positive or negative) of the securities you "buy."

Fantavision *animates simple drawings. In this example, the kite moves back and forth across the screen.*

EDUCATION

Animation Generator Brings Drawings to Life

BY MATTHEW J. ROSS

Fantavision, from Broderbund's Creative Workshop Series, is a slick animation and special-effects generator. Designed for ages 8 to adult, it is a fun way to develop your child's artistic skills, and maybe even stimulate your own dormant creativity.

Using a mouse, you can draw up to 16 geometric objects, including squares, circles, and triangles, in a frame. These objects can be cut and pasted into different frames, rotated, and made larger or smaller with the zoom feature. After you create a series of different frames, *Fantavision* fills in the gaps, generating as many as 64 in-between frames, producing smoothly animated special effects.

Watch as your objects move across the screen, change colors, and spin. You may view your movie at different speeds, change an object's perspective from one frame to the next, and draw background images to create an eye-catching stage for your action.

After you've gotten the effects just right, pull down the Sound menu and select from several ready-made sounds: a dog's bark, a bird's chirp, or a laser's blast. Among other choices are "pops" and "creaks." *Fantavision* even allows you to customize your own sounds by specifying frequency and duration. Enter the sounds into the desired frames of your movie, hit GO, and see and hear your cinematic masterpiece come to life.

Fantavision's clear instructions and interface make this program easy to learn; you will be making simple special effects in an hour. A selection of impressive, ready-made movies and effects comes on an additional disk. See a polar bear cleverly drawn with stick figures. Watch an erupting volcano, or follow an eagle as it majestically swoops across your screen.

As with most art or drawing software, talent is required for really eye-catching results. This doesn't mean you can't have fun if you can't draw. Just don't expect to create Lucasfilm results if you don't have some artistic ability.

List Price: *Fantavision*, $49.95. **Requires:** 256K RAM, mouse, graphics adapter, DOS 2.0 or later. Not copy protected. Broderbund Software Inc., 17 Paul Dr., San Rafael, CA 94903; (415) 492-3200.

CIRCLE **646** ON READER SERVICE CARD

HANSON & CONNORS'

PC EXCHANGE ACCOUNTING

BEDFORD ACCOUNTING

(Bedford Software)

"The Perfect System for your Growing Business."

BEDFORD ACCOUNTING is a completely integrated accounting system that includes General Ledger, Payroll, Accounts Receivable, Accounts Payable, Inventory and Job Cost. Use each module as an independent software package...or combine modules to form your completely coordinated accounting package.

BEDFORD allows for greater flexibility in your reports, supports a completely user defined chart of accounts, manual or computer produced checks (even for payroll), keeps track of full or partial payments by customers, allows you to make full or partial payments to vendors, and offers quick pop-up capability to let you look up accounts and inventory information.

The **BEDFORD ACCOUNTING 5Y5TEM** was judged to be PC Magazine's Editor's Choice in a review of 59 accounting packages conducted by Price Waterhouse. "This is truly a (complete accounting) system. Bedford's six modules...are easy to install, easy to use, and so well integrated with one another that it makes accounting a snap—even for non-accountants."

BEDFORD ACCOUNTING...IBM VER5ION.....$249
BEDFORD ACCOUNTING...MACINTO5H VERSION.....$249

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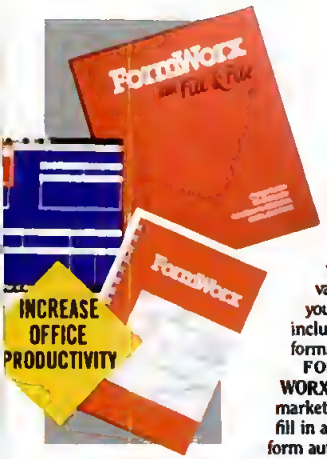

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ON-LINE SERVICES

CompuServe Role-Playing Games: A Respite from the Mundane World

BY BILL O'BRIEN

We've had fantasy for as long as we've been ourselves. A million years ago you could spark your mind by dreamily contemplating the latest cave drawings. Today, there is a whole universe—or, more accurately, there are many universes—of dungeons, dragons, good, and evil waiting for you on-line. The PC's telecommunications capability is the key to these vast realms.

Communications services like CompuServe and The Source bring formerly isolated dreamers together in what could be called "gang fantasy." The frontiers of the imagination are explored by communities of connected users, united by nothing more than a phone line and the world of multiuser, on-line games.

Many such game theaters thrive on CompuServe, where perhaps the most-ardent players engage in *role-playing games* (RPGs). For the novice, relatively simple, maze-oriented RPGs like BlackDragon and the Island of Kesmai lead your character through dungeons, tunnels, gardens, and castles as you encounter all manner of challenges.

Throughout it all, your character's attributes (strength, intelligence, wisdom, stamina, luck, and so on) wax and wane according to the choices you make in dealing with your surroundings. These games provide relatively low-level graphics with slashes and brackets used to represent stairs and walls. Alphanumerics might represent creatures, treasures, or other objects of interest.

Gamesters looking for more challenge can head for CompuServe's British Legends, a game where character creation is slightly more involved. Still based on maze theory, British Legends hosts a multiplayer scenario where you can interact with other CompuServe users' characters while exploring the countryside. You may talk to them, steal from them, or fight for or against them.

Camaraderie and large-scale player interaction are rampant in British Legends—so much so that more-sophisticated players may be put off by it. Scene descriptions, for example, often scroll off the screen as players communicate back and forth on topics hardly related to the adventure at all.

Still other games on CompuServe use the information service simply as a central meeting place for the players. Actual play takes place by mail, in much the same way that chess can be played through the postal service.

Xenophobe is one such CompuServe game. In Xenophobe, a player decides which of several races (Terran and Alien) he wishes to be, and how many spaceships he wants. (Moderator Jim Townsend estimates that only about 3 percent of the players are women, hence the masculine pronoun.) Then the intrepid gamester sets off to conquer the Xenophobe universe.

That universe is vast and, after 2 years of play, mostly unexplored. The intensity of play is reflected in the game rules and procedures. Order a ship, for instance, and you must also fit it out with engines and a command center. Players can form trade and military alliances and establish colonies.

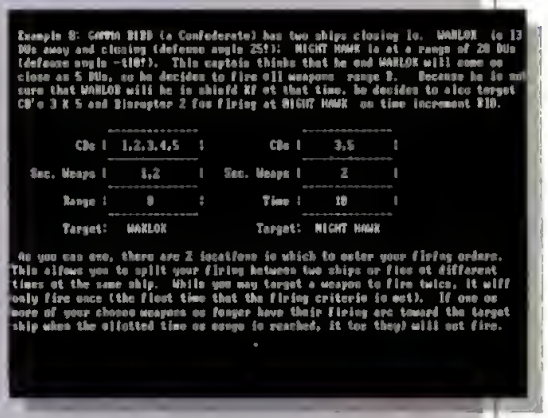
All of this is done, of course, by mail. Each turn is accompanied by a check to cover the cost of computer time used to analyze a move. Your ambition dictates the amount of money you'll spend, but Townsend has built some limits into Xenophobe that prevent the more affluent players from dominating the game through money alone.

The people who play the games are as interesting as the games themselves. Some consider playing their roles a form of relaxation. Others are more intense.

Some players live through their real-world days just to get on-line and engage in their fantasy roles. After all, commanding a space army is a lot more fun than getting yelled at by the boss for losing a box of paper clips. CompuServe's role-playing games are one of the most exciting facets of the information service, because they link the PC community in a network limited only by the minds of the users.

List Price: CompuServe Role-Playing Games. Standard CompuServe rates; additional charges for some games. **Requires:** Modem, communications software. CompuServe, 5000 Arlington Centre Blvd., Columbus, OH 43220; (614) 457-8600.

CIRCLE **644** ON READER SERVICE CARD



Strategy, preplanning, and intuition decide the outcome of confrontations in all CompuServe RPGs. Graphics are rare because of the variety of screen formats supported.

AFTER HOURS INDEX

CompuServe Role-Playing Game:
Your modem is the ticket to alien worlds and epic struggles on far-off planets.
The Source's Fourth Portfolio Contest
An on-line game for armchair arbitrageurs.
Fantavision
Animation system brings your artwork to life.
Manhunter
A gory vision of humanity ruled by aliens.
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An arcade favorite makes it to the PC.
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C ☐ Over 21

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For us, however, fast enough is not enough.

By utilizing an Intel^ 82385 Cache Memory Controller, page mode RAM and interleaved memory, the 310 not only delivers all that speed, but enough horsepower to do everything from CAD/CAM to megaspreadsheets to databases the size of the Manhattan Yellow Pages.

It even has the umph to work as a network file server.

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The System 310 comes standard with 1 MB of RAM. Want more? We can add as much as 8 MB to the system board. Still not enough? We can add still another 8 MB by installing a high-speed memory expansion board.

You can even run your 310 as either a MS-DOS,® OS/2 or UNIX® system. It's your call.

The same holds true for monitors. You can choose between VGA mono or VGA Color Plus, for high resolution colors displayed on a larger screen.

The point here is that when you order a System 310, you not only get a 386-based system that's incredibly fast, powerful and versatile, but incredibly personal as well.

PC MAGAZINE EDITOR'S CHOICE

"You will have to look far and wide to find a better price performan package for the power-user lurking inside you."

(November 29, 1988)

For the full story, see inside back cover.

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